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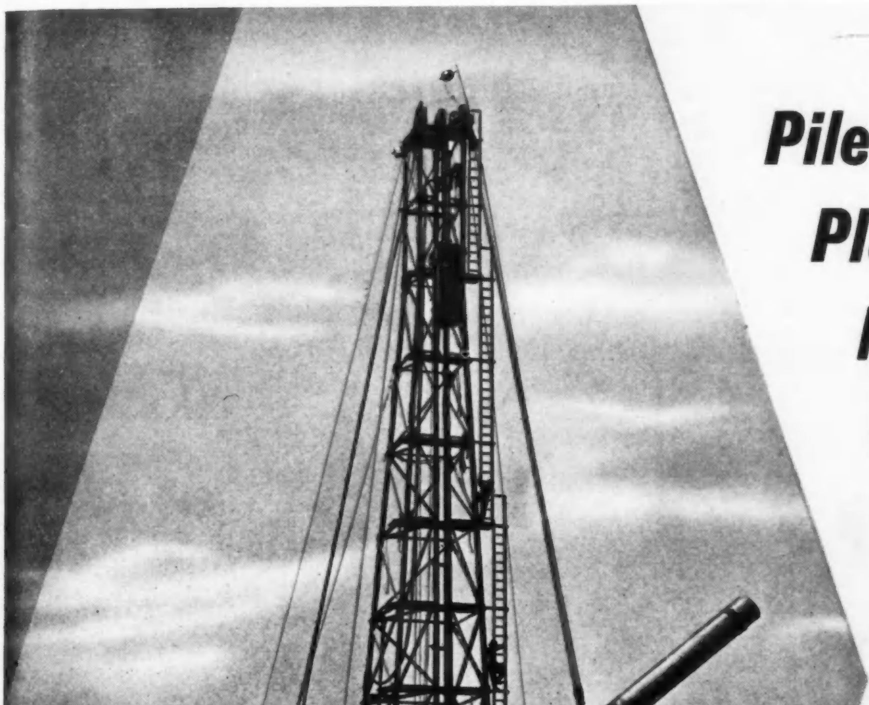

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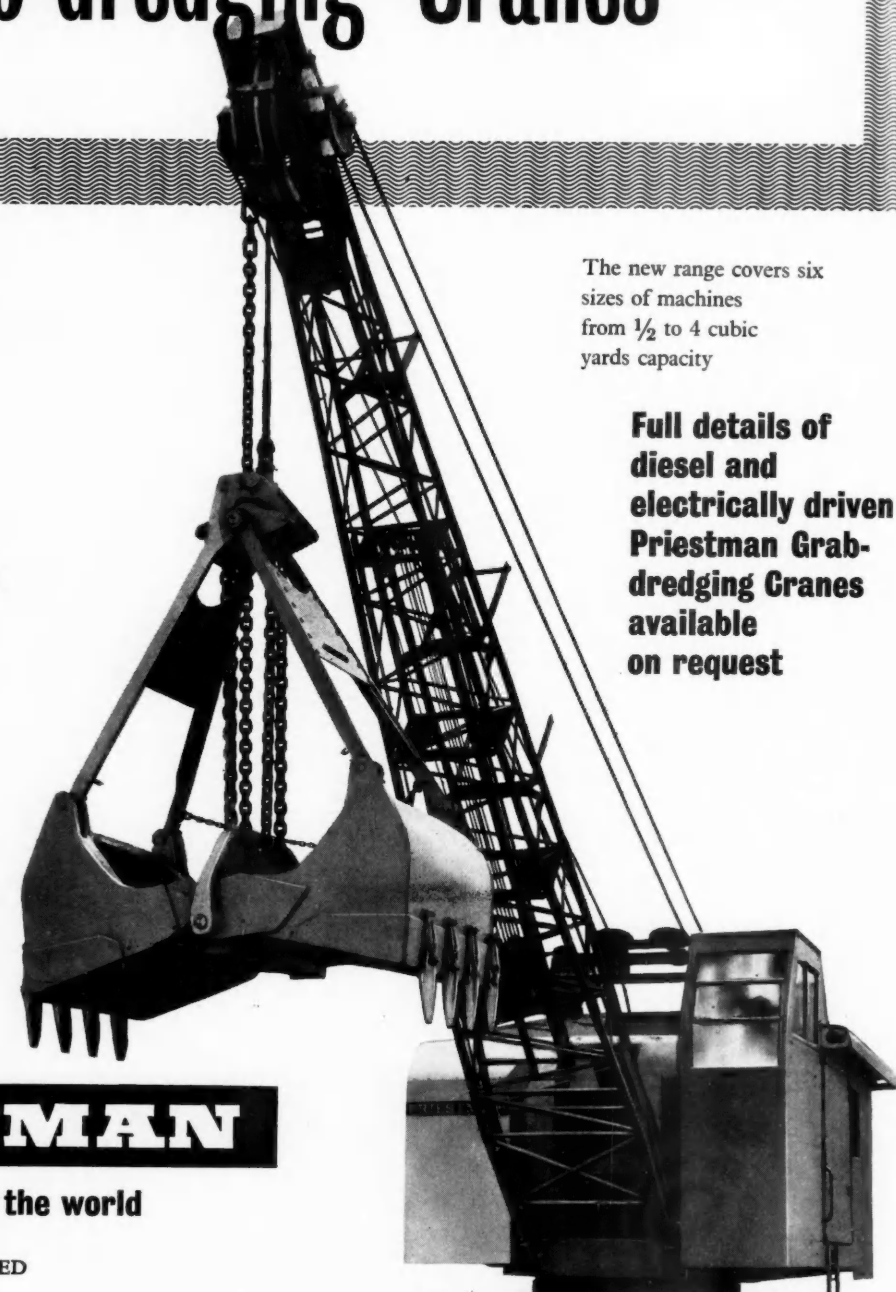

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The Dock & Harbour Authority

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No. 460

Vol. XXXIX

FEBRUARY, 1959

Monthly 2s. 6d.

Editorial Notes

The Ports of New South Wales

Our leading article for this month gives an interesting account of the work and responsibilities of the Maritime Services Board of New South Wales, which acts as the port and navigation authority of this progressive Australian State. The review, which has been kindly supplied by the Secretary of the Board is chiefly devoted to the four major ports of Sydney, Newcastle, Port Kembla and Botany Bay, and gives details of their present accommodation and equipment.

Readers will observe that, although New South Wales occupies only about one-tenth of the total area of Australia, its growth and industrial development since the war has been remarkable and this rapid expansion has presented the Maritime Services Board with many problems in providing the necessary port facilities and ancillary services for shipping. The Board is to be congratulated on the progress so far achieved and there is every indication that this steady development will continue.

The Annual Report of the Board, which was published recently, states that for the Year Ended 30th June 1958 the volume of cargo handled at the four major ports amounted to nearly 25 million tons. This showed a substantial increase of one and three quarter million tons on the previous year, and the total is nearly twice as much as was handled in any other State of the Commonwealth, and approximately 40% of the seaborne trade of Australia as a whole.

The cargo handled in Sydney totalled 8,056,991 tons and showed a slight improvement on the previous year's figure. More than 4 million tons of oil cargoes were handled at Botany Bay which means, in effect, that the total cargo tonnages for the Sydney Metropolitan area handled through both ports amounted to more than 12 million tons.

The ports of Newcastle and Port Kembla, which are both principally bulk cargo ports, showed further substantial increases in tonnages handled and reflect the expansion taking place in the heavy industries situated in these areas. At Newcastle, the total cargo handled amounted to 8,445,249 tons, an increase of some 306,000 tons when compared with the previous year and at Port Kembla the increase amounted to more than 354,300 tons to achieve a record figure of 3,990,631 tons.

A slight improvement was also recorded for the 28 minor ports of the State which are administered by the Board but, generally speaking, most of the outports are now used chiefly by vessels engaged in the fishing industry.

Smoke Emission from Ships in Port

The Clean Air Act of 1956, which came into force on 1st June last, contains regulations concerning the prohibition of dark smoke from chimneys and vessels which are of direct concern to port authorities throughout the United Kingdom. We are therefore printing on page 307 of this issue a Paper by Mr. G. E. Stanley of the Manchester Port Health Authority which was presented last September at the Annual Meeting of the Association of Public Health Inspectors. Mr. Stanley gives much useful information regarding the new legislation and explains the obligations and duties of Port Health Authorities under the new Act. In his concluding remarks, he also points out that heavy smoke from shipping is, in some instances, one of the chief causes of air pollution and that although "prosecutions will doubtless be taken and have their effect, the main duty will be endeavouring to convince, educate and obtain the co-operation of all concerned."

It is of interest to note that under the new Act, a leading shipping company was summoned last month by the City of London Corporation for the excessive emission of black smoke at Tilbury Docks from one of their oil-burning cargo vessels. Although the owners submitted extenuating circumstances, a fine of £25 and £10 10s. costs was imposed. This appears to be the first prosecution of its kind since the 1956 Act came into force and serves to emphasise the manner in which the provisions of the Act may affect all types of shipping and ancillary craft which do not maintain effective smoke control.

An important contribution towards cleaner air has been made by the Fuel Research Station of the Department of Scientific and Industrial Research, who have designed and developed two types of smoke eliminators, one for natural draught hand-fired land and marine boilers and the other for similar boilers with forced draught. A new smoke density indicator has also been developed which is claimed to provide a simple, efficient and immediate means of detecting the emission of dark smoke. The new equipment is now being manufactured under licence by a London engineering concern.

Working Relations at the Docks

Considerable interest has been evinced in the article by "Poseidon" which appeared in our October issue, and on a following page we publish his summing-up of the correspondence which was printed in subsequent issues. Lack of space prevented the publication of all the letters received, but those selected represent a fair cross-section of views and show that a solution to the problem will not be easy to achieve. Nevertheless it is hoped that some progress will result from the discussion.

Several correspondents advocated the establishment of a pension scheme for dockers over 65 years of age. This suggestion has already been the subject of discussion between the employers and the unions for some time past and at a meeting of the National Joint Council for the Port Transport Industry held last week, the Council heard submissions by the unions for retirement allowances and sick pay benefit which the employers have undertaken to consider. At the same meeting it was agreed that the main fall back guarantees for dock workers will be increased from £6 1s. to £6 12s. per week.

The Dock and Harbour Authorities' Association

At the annual meeting of the Dock and Harbour Authorities' Association, held in London last week, Sir Kenneth Sinclair, chairman of the Belfast Harbour Board, was elected President of the Association in succession to the Duke of Buccleuch and Queensberry (Port of Granton). In the absence of the retiring president on business abroad, the chair was taken by Mr. B. Eliot Common, chairman of the Tyne Improvement Commission and a vice-president of the Association.

Editorial Notes—continued

In his address, Mr. Common said that, under the Nuclear Installations (Licensing and Insurance) Bill, a duty was cast on a licensee, or the Atomic Energy Authority, where they operated a site, to secure that no ionising radiations were emitted from any irradiated nuclear fuel in course of carriage between places in the United Kingdom, and licensed persons were also required to take out cover in respect of this risk. He pointed out that dock and harbour authorities were concerned in this matter in that such cargo might be carried partly by coastal vessels and they might be equally concerned in the carriage of fuel oversea. This would raise important and complex problems, particularly in relation to liability, which would clearly require careful consideration. It might be that the domestic proposals contained in the Bill, would serve as a pattern for international agreement.

Moving the adoption of the Association's annual report, Mr. F. D. Arney (Port of Bristol) chairman of the executive committee said it had been a fairly heavy year for the Association, particularly in relation to Parliamentary legislation. He referred to the taxation changes which could act to the disadvantage of port authorities, and said that an approach had been made to the Treasury on the subject of the restoration of investment allowances for plant and buildings. While the Association had not been successful in obtaining any alleviation in the 1958 Budget they were not prepared to let the matter rest and would continue to press their case.

Referring to the Factories Bill, Mr. Arney said the Association had raised with the Ministry of Labour the question of the effects of the application of the provisions of the Bill in so far as they applied to a ship in a dry dock. As a result of discussions, the Ministry had agreed that, so far as dangerous fumes were concerned, the matter would be dealt with in the Shipbuilding and Shiprepairing Regulations which were at present being revised and that the provisions of the Bill would not be applied to ships in dry dock. Where fire fighting provisions are concerned, the Association had made it clear to the Minister that a sub-clause in the Bill requiring the provision in every factory of appropriate means for fighting fire would place a very heavy burden upon owners of a public dry dock if it extended to the fighting of a fire on a ship for the time being in dry dock. The Association had asked that this matter also should be dealt with in the Shipbuilding and Shiprepairing Regulations and that a provision should be included in the Bill providing that the fire fighting provisions of any regulations made under the Bill in respect of fire fighting would not apply to a ship in dry dock. The Ministry have recognised the special position of port authorities and are still considering how best this could be met either by a provision in the Bill or by granting an exemption in proper cases.

Commenting on the subject of limitation of shipowners' liability and the exclusion of wreck removal costs in the private Bill introduced in Parliament last year, Mr. Arney said that port authorities were not prepared, having had experience of the costs of wreck removal, to shoulder any additional burden, and while they were not contesting the clause, they were concerned for their financial protection. With the assurance they had received from the Minister of Transport that coming into force of the provisions would be withheld until a fund had been set up to meet the expenses caused by wreck removal, the Association could be certain that their interests were protected.

New Railway Rates for South Wales Ports

For some years past, the Industrial Association of Wales and Monmouthshire and other Welsh interests have been actively engaged in trying to resolve the anomalous position of South Wales ports vis-à-vis other United Kingdom ports with regard to railway rates. In 1955, after the issue of the new Railway Charges Scheme, a committee of the Dock and Railway Authorities was set up to undertake an urgent and exhaustive review of the level and content of rates for port traffics with a view to resolving the position. The endeavours of the Association's general cargo sub-committee in this matter culminated in a delegation from the Association being received by the Chairman of the British Transport Commission, in October last year.

It has now been officially announced that the British Transport Commission have agreed to apply to their ports in South Wales a new system in respect of railway rates on export and import traffic. The new arrangement is virtually identical with that currently in operation at the port of Liverpool and will come into force on May 1st.

The new rates will apply to merchandise, with certain exceptions, through the ports of Newport, Cardiff, Barry, Swansea and Port Talbot, and are inclusive of rail conveyance within the docks, loading into wagon (imports) and unloading from wagon (exports). The transit shed services, shipping from quay to vessel, or receiving from vessel to quay will continue to be excluded from the railway rate. The exceptions to the new scheme will be timber, liquids in bulk, solids in bulk, loose traffic such as bricks and slates, returned bogies and meat, and for these commodities British Railways will introduce new rates.

Having achieved one objective, the Industrial Association of Wales now hope to persuade the British Liner Committee to recommend to their members that they accept the same proportion of f.o.b. labourage charges as the liner companies do at Liverpool. At a meeting held early in 1957, the British Liner Committee suggested to the Association that "it might help regarding dock charges if the B.T.C. were prepared to play their part by agreeing to a reduction in the total charges." As this condition has now been met the Association has good grounds for anticipating that their recommendation will be accepted.

International Course in Hydraulic Engineering

The third session of the International Course in Hydraulic Engineering, which is jointly organised by the Delft Technological University and the Netherlands Universities Foundation for International Co-operation, will be held at Delft, Holland. The course will commence on October 21st, 1959, and will last eleven months with four one-week intervals for holidays. Instruction will be given throughout in English.

As it is obvious that each participant will have a special interest in those subjects which he is likely to encounter in his later career, arrangements have been made to enable him to adapt the programme to his personal requirements. The programme allows a choice between three alternative branches of study:

(1) Tidal and Coastal Engineering (including harbours).
(2) Rivers and Navigation Works (including recovery of ground water).
(3) Reclamation.

The Course comprises lectures, group discussions, working visits and a period of practical work. It is divided into two terms in which classes are held, a period of practical work and a final term. During the first two terms there will also be opportunity to visit and and study the extensive Dutch hydraulic engineering projects which are now under construction or will be started in the next few years.

Professor J. Th. Thijsse, Director of the Hydraulic Laboratory at Delft is general adviser of the course, at the end of which a Diploma in Hydraulic Engineering will be awarded to those who have made sufficient progress.

Readers who are interested in obtaining further details should apply to the Netherlands Universities Foundation for Interational Co-operation, 27 Molenstraat, The Hague, Holland.

Engineering Exhibition in London

The Engineering, Marine, Welding and Nuclear Energy Exhibition, traditionally held in the Autumn, has been rearranged to open from April 16th to April 30th next. It will occupy the three halls of Olympia, London, comprising more than a quarter-million sq. ft. of stand space.

There will be more than 1,000 categories of engineering products and plant on show, including the latest developments in nuclear energy equipment. The exhibitors' stands will be staffed by technicians able to offer visitors advice on any problem.

Intending visitors from abroad can obtain all information regarding travel and accommodation from The American Express Company, or Thos. Cook & Sons Ltd., the official Travel Agents to the Exhibition. An interpreter staff will be available for those who require it. Details of the Exhibition itself can be obtained from the Organisers, F. W. Bridges & Sons Ltd., Grand Buildings, Trafalgar Square, London, W.C.2.

The Ports of New South Wales

An account of the Work and Responsibilities of the Marine Services Board

By S. COHEN
(Secretary, Maritime Services Board of N.S.W.)

ALTHOUGH, in area, the State of New South Wales occupies only a little over 10% of the Australian continent, its borders contain about 38% of the total population and its 22,000 factories provide employment for 433,000 men and women, more than 40% of the total Australian factory labour force. In addition, more than 120,000 people are engaged in rural production in the State and during recent years the New South Wales wool clip has realized an average of about £180 million, almost half the total value of wool production for the whole of the Commonwealth.

In mineral production, too, New South Wales is very much to the forefront, as 80% of Australia's total black coal production is derived from the rich deposits found in the central coastal area around Sydney which is bounded roughly by Newcastle in the north, Lithgow in the west and Port Kembla in the south. This wealth in coal is the basic reason for the State's virtual monopoly in steel production, practically all the Nation's requirements of this commodity being produced in Newcastle and Port Kembla where many millions of pounds are being spent on further development of the steel industry.

The rapidly expanding industrial economy of New South Wales has presented many special problems for administration in aspects of government, and these problems are not least in the field of port administration where it is vitally essential to keep abreast of the demands posed by modern transport upon which depends the smooth flow of trade and commerce.

As the port, navigation and pilotage authority for the whole of the State, the Maritime Services Board of N.S.W. is responsible for the administration and control of all ports and harbours in New South Wales including river entrances, ocean jetties and the inland navigable waterways. In Sydney, the Board's functions include the provision and maintenance of wharfage, channels and port facilities but, at the other ports, development and maintenance work is carried out by the New South Wales Department of Public Works. The total capital expenditure at all New South Wales ports exceeds £30 million.

Just as the main industrial area of New South Wales is centred on Sydney and the central section of the coast, so too are the major ports. Newcastle and Port Kembla are both within a radius of a little over 60 miles from the Port of Sydney and Botany Bay is within six miles. These four ports now handle well over 24½ million tons of cargo per year.

PORT OF SYDNEY

The Port of Sydney, which has developed into one of the world's major ports, has many natural advantages. Not only is it renowned for its scenic beauty, but because it is almost completely landlocked, it has the added attraction of being one of the safest and most convenient harbours in the world. The average width of the harbour is slightly less than one mile and there are approximately 152 miles of foreshore bordering the various arms and bays which provide excellent shelter for shipping under even the most adverse of weather conditions. The world's largest vessels may enter the port in complete safety at any state of the tide, and, during World War II, when Sydney was the base for the British Pacific Fleet as well as a supply base for American operations, the "Queen Mary" and "Queen Elizabeth" were frequent visitors. Four ships of the "Queen" type could be accommodated comfortably in the harbour at one time, in addition to many other vessels. The largest number of seagoing ships actually recorded as being in the port at one time is 194, this figure including a considerable proportion of vessels of the larger type.

Three 20-ton cranes are provided on the modernised rail berths at Balmain for the handling of export coal and other bulk cargoes.

From the viewpoint of both commercial and shipping interests, the principal wharfage is most conveniently located within four or five miles from the sea and within one mile from the heart of the city. Approximately 14 miles of commercial wharfage in the port provide 111 general cargo berths and a number of special berths for handling bulk cargoes such as oil, timber or coal. Depths ranging up to 40-ft. are available at some oversea shipping berths.

General cargo in the Port of Sydney is mostly handled with ship's gear, but wharf cranes and other mechanical equipment are available at selected berths. Some of the sheds are equipped with travelling bridge cranes but, in common with modern practice, Sydney favours the provision of mobile equipment for handling cargo inside the sheds as well as to and from the ship's side. Floating cranes with capacities up to 150 tons and the 250 ton crane at the fitting-out-wharf adjoining the Captain Cook Graving Dock can be used for the handling of heavy lifts.

Reconstruction and Modernisation Plans

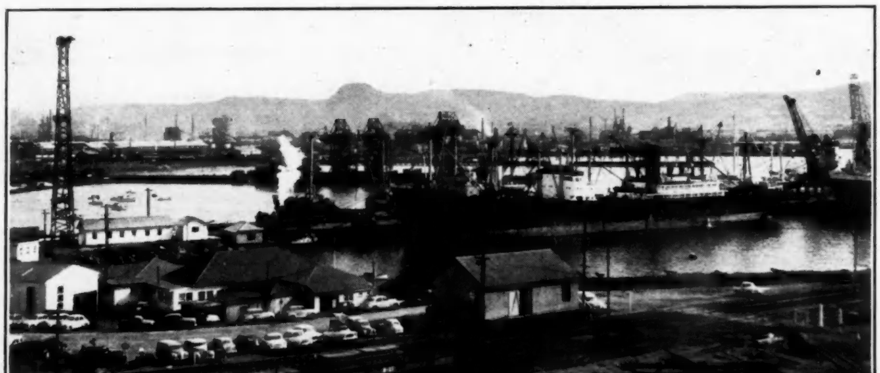
To meet the present and anticipated accommodation needs for shipping and commerce at the Port of Sydney, the Board has adopted development plans for the reconstruction of existing wharfage, the extension of facilities for the oversea trade and the development of waterfront areas to be used as industrial sites associated with port activities.

Extensive reconstruction and modernisation have been carried out during recent years. At Balmain, two modern rail berths have been equipped with 20-ton cranes for the handling of coal and other bulk cargoes and, at Pyrmont, five new oversea berths have been placed in service. Cargo sheds at these Pyrmont berths are up to 500-ft. long and 120-ft. wide, and, in common with other sheds recently built have doorways 26-ft. high and 17-ft. wide to facilitate the movement of mobile cranes and other cargo handling equipment.

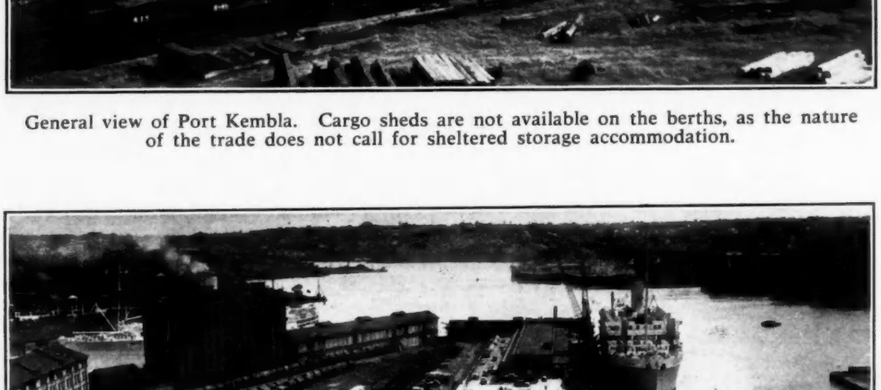
To cater for the growing passenger and tourist traffic, a specially designed two storey brick building was erected at one of the Pyrmont wharves with facilities for passengers, visitors, and baggage on the upper level, separated from cargo handling operations on the lower deck. Following the success of

Ports of New South Wales—*continued*

View showing the entrance to the Port of Newcastle, through twin breakwaters. Approximately two million tons of raw materials are imported into Newcastle each year for use in the steel industry.



General view of Port Kembla. Cargo sheds are not available on the berths, as the nature of the trade does not call for sheltered storage accommodation.



The passenger terminal at No. 13 Pyrmont which provides modern facilities for the tourist trade. All cargo is handled at wharf level leaving the upper storey clear for passengers and baggage.

this Pyrmont terminal, which was the first modern, spacious structure of such type built in Australia, the upper floor of a two storey cargo shed at Woolloomooloo was converted for use by passengers and the construction of a third special passenger berth and terminal of still larger size has been commenced in Sydney Cove. The Sydney Cove terminal, which whould be the qeual of any in the world, will be completed in 1960 for the new 40,000 and 45,000 ton passenger vessels which will enter the United Kingdom-Australia trade. In Darling Harbour, other new cargo berths and sheds are nearing completion, while a start has been made on demolition to make way for the first three of nine new solid-fill berths with sheds 120-ft. wide and internal roads 160-ft. wide.

In case future needs require expansion of facilities byond the present developed areas of the port, the Board has prepared long range plans for the construction of wharfage for oversea vessels in Rozelle and Blackwattle Bays and the Balmain area.

As part of the plan to provide more harbourside factory sites for industries associated with the trade of the port, the Board is engaged in an extensive reclamation programme at Homebush Bay, in the upper reaches of the Parramatta River, where more than 400 acres of tidal swamp are being converted into valuable waterfront land.

Cargo tonnages handled at the Port of Sydney usually rage from eight to nine million tons per year and as a result of the planned diversion of a large section of the bulk oil trade to Botany Bay on the southern fringe of the city's industrial area 4 million tons of Sydney's oil cargoes are now handled there each year. During the year ended 30th June, 1958, the total cargo tonnages for the Sydney metropolitan area handled through Sydney and Botany Bay amounted to well over 12 million tons.

At present there are two oil refineries and three bulk oil terminals at Botany Bay. Tankers serving the £25 million refinery at Kurnell berth at the company's jetty with accommodation for two tankers adjacent to the refinery, but bulk oil cargoes for the refinery and storage terminals on the northern side are pumped ashore through submarine pipelines from tankers at moorings in the bay.

Up to the present, Botany Bay has been used solely for the handling of oil cargoes but its development for both bulk and general cargoes is envisaged should future industrial expansion warrant additional facilities.

PORT OF NEWCASTLE

Newcastle Harbour at the entrance to the Hunter River, 62 miles north of Sydney, is a bar harbour port with an area of about 730 acres. The entrance, between two breakwaters, has a depth of 25-ft. 6-ins. at low tide but work is in hand to increase this to 32-ft.

The total length of commercial wharfage is approximately 3 miles, with depths ranging from 28-ft. to 30-ft., and there are a number of dolphin berths available for tie-up purposes.

General cargo is handled by ship's gear, but cranes are used for loading coal at the

Ports of New South Wales—continued

Dyke and Basin wharves and steel products at the steelworks wharfage. In addition a coal loading plant of the conveyor-belt type has been placed in service recently at the Dyke wharfage. Heavy lifts are handled by an 80-ton floating crane and a 50-ton crane is available at the State Dockyard fitting-out wharf where there is a depth of from 18-ft. to 20-ft. at low water.

In addition to the deepening of the rock bar at the entrance, development works at present under way at Newcastle include the construction of new wharves and cargo sheds, and the reclamation of the extensive and "islands" area stretching north and west from the upper section of the harbour in the vicinity of the steelworks, where further berthing facilities are proposed in the reclaimed area. A master plan for the future which has been prepared in conjunction with other authorities concerned, provides for the construction of a shipping basin, in planned stages, at Throsby Creek, in close proximity to the city, which will, eventually, enable the abandonment of a number of the older commercial wharves at present in use.

PORT KEMBLA

Rapidly expanding as the third port of New South Wales, Port Kembla, 44 miles south of Sydney, is an artificial harbour protected by breakwaters with a designed entrance width of 1,000-ft. enclosing an area of 340 acres. The depths in the harbour range from 50-ft. at low water in the entrance to from 17-ft. to 40-ft. at the jetties.

There are three Government jetties, one berth for imports of inflammable liquids and one privately owned jetty for imports of ore and other raw materials for the steel industry. No cargo sheds have been provided to date, as the special nature of the trade at the port, serving mainly the steel and other heavy industries, coal, oil and phosphate trades, does not call for the provision of sheltered storage accommodation at the berths.

The steady increase in the volume of cargoes from about 1½ million tons ten years ago to almost 4 million tons during the year 1957/8, and the anticipated further expansion of trade associated with the major expansion of the steel industry call for the provision of additional port facilities. A new jetty to be known as No. 6 Jetty is being constructed, and when completed will provide 950-ft. of berthing accommodation on each side with depths ranging from 28-ft. to 32-ft. at low water.

In addition to this new berth in the existing harbour, the accelerated industrial growth of the Port Kembla district has led to a plan for the construction of an inner harbour in the low lying land between Wollongong and Port Kembla. This work, which is being carried out under the direction of the Department of Public Works has been commenced and, in the first stage, will provide four berths along the steel works frontage for the bulk handling of iron ore and limestone, and five general cargo berths. The second stage of the plan makes provision for expansion of the Basin in a northerly direction and an ultimate total of 64 berths in the Basin and existing outer harbour. A short account of the progress of this scheme follows this article.

A new wharf nearing completion in Port Kembla's outer harbour. The steel piping seen in the illustration is to be laid beneath the harbour for the use of oil tankers discharging at a jetty beside the eastern breakwater.

The Walsh Bay wharfage is used by both oversea and interstate vessels. The main port roadway, seen in the left of the illustration will extend, when completed, from Circular Quay through the Walsh Bay and Darling Harbour areas to Pyrmont seen in the background, to the left.

OUTPORTS OF N.S.W.

Apart from the four major harbours at Sydney, Newcastle, Port Kembla and Botany Bay, there are 28 minor ports in New South Wales. These were once of considerable local importance and handled a comparatively large volume of trade but, with the extension of the railways and, in more recent times, the increased use of road transport, many of the coastal shipping services have been suspended and the majority of these outports are no longer used by trading vessels. However, timber is still exported to both oversea and interstate destinations from Clarence River, Coff's Harbour and Twofold

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Development of the Inner Harbour at Port Kembla

Readers of this Journal will recall that in our April 1957 issue we published an article describing the plans in hand for the proposed inner harbour for Port Kembla in New South Wales. The construction was planned in two stages; the second may not be initiated for some time. The first stage comprises an extensive dredging programme to remove more than 4,000,000 cu. yds. of sand and rock to widen the present narrow entrance into the Tom Thumb lagoon, and form a 4,500-ft. basin to accommodate the deep-draught vessels. The main road is to be diverted round the new works at a cost of £A800,000. The Department of Public Works is to construct government wharfage on the southern and north-eastern boundaries of the harbour and the Australian Iron and Steel company, which owns most of the land to the south-west of the site, was granted the right to construct its own 1,100-ft. wharf with depth alongside of 38-ft. at low water.

The depth of the inner harbour is to range from 32-ft. to 36-ft. in its deeper sections and the Department of Public Works has let two contracts for this dredging work, at a total cost of £A1 million. It is being carried out by a joint United States-Australian syndicate, the first contractor being composed of three companies, the Gahagan Dredging Corporation (U.S.), Waterways Improvement Corporation (U.S.), and the Port Kembla Dredging Co. Pty. Ltd., who have contracted to complete the work by July, 1959.

This association, registered as Gahagan Australia Associates, is carrying out at the same time a large contract in the port of Bundaberg, one of Queensland's major agricultural and sugar-producing centres.

At Port Kembla, the dredging is being executed by modern cutter-suction methods and some 300,000 cu. yds. of spoil is being removed per month.

The second contractor is the Australian firm of McDonald Construction Pty. Ltd., which is using a 250-ton dragline to remove an estimated 400,000 cu. yds. of rock and boulders. Due to its size, this walking dragline has had to be mounted on a specially-designed pontoon, 90-ft. long and weighing 150 tons. This was built by Mort's Dock & Engineering Co. Ltd., shipbuilders, and towed 60 miles by sea to Port Kembla.

The dragline, which takes steps of 7-ft. with each movement, is now engaged in what is believed to be the largest underwater rock excavation ever undertaken in Australia. The work is further complicated by the need to use explosives to break up the large outcroppings of rock beneath the surface fo the lagoon.

Ore Handling Wharf

While the extensive dredging programme is in progress, the Australian Iron and Steel Company has built its own wharf at a cost of some £A2 million. It is 1,100-ft. long and 50-ft. in hieght and constructed with a solid gravity-type front wall with backfill behind.

The inner harbour wharf at Port Kembla in course of erection, which when completed will provide accommodation for large iron ore freighters up to 40,000 tons.

The excavation work was carried out by a private dredging contractor and later by a large earth-moving company and, in all, more than 200,000 cu. yds. of silt, soft clays and sand were moved. In addition, about 8,000,000 gallons of water had to be pumped from the site when heavy rains inundated the partially completed work.

The design of this wharf is unusual. The concrete facing is 4-ft. 6-in. thick, widening to a footing of 32-ft. More than 27,000 cu. yds. of concrete were used in the construction of the front wall, which was also reinforced by 2,000 tons of steel bars. It has a lateral top section projecting 8-ft. from the main face and a boxlike concrete structure that carries service mains for oil fuelling, compressed air, fresh water and electricity supply. To prevent ships with a small freeboard from damage against this overhang, or drifting against it, timber pile fenders are to be installed.

An entirely new feature in wharf design has been introduced which is believed to be the first of its kind in the world. This consists of a series of surge pipes let into the face between high and low water levels. Each pipe has a diameter of 6-ft. with centres 18-ft. apart, and inclined downward at a slight angle for 48-ft. into the wharf.

The idea was conceived in the Civil Engineering research laboratories of the University of Sydney, which had been asked by Australian Iron and Steel to propose some way of reducing action of surge waves in the inner harbour. The recommended design was then tested in a scale model of the complete harbour, which the Department of Public Works had already used for experimental purposes in Sydney.

This new wharf is soon to be fitted with a heavy superstructure consisting of two 80-ft. high travelling ore unloaders and a steel loading bridge with a span of 270-ft. These installations will enable the ore to be handled direct from the ship to the stockpile behind the wharf, and then to the furnace when required.

Provision for the ore stockpile with a capacity of 750,000 tons brought fresh problems. The foundation for the projected bridge and ore stack was found to consist of 60-ft. of clay and soil with a rock base, which was not strong enough to support the great weights estimated. Hence, new foundations had to be made by first excavating and then filling with rock, rubble and large quantities of slag from the furnaces.

Ports of New South Wales

(concluded from previous page)

Bay; road metal is brought to Sydney from Kiama and bulk sugar and milk products are transported to Sydney by sea from some of the northern river ports.

Because of the decline in coastal trade, there is a general tendency to overlook the important contribution which the outports have made—and could still make—to the development of the State and the essential need which they have filled in the field of commerce.

New Tanker Terminal at Mena al Ahmadi

The North Pier at Mena al Ahmadi, which is being built for the Kuwait Oil Co. Ltd., four miles north of the existing South Pier, is nearing completion, It is an 'L' shaped structure with an approach leg of some 5000-ft. and a head of 2300-ft. The pier will have berths for five tankers and will be able to berth two 50,000-ton tankers and two 100,000-ton tankers simultaneously. Three new gravity lines will permit loading rates of up to 50,000 barrels an hour to be achieved.

Modification of the Sea Bed with a view to Concentration and Dispersal of Sea Waves

By F. VASCO COSTA and J. FIUZA PERESTRELO*

There is a close analogy between sea waves and light waves. Both behave in the same way in refraction, diffraction, simple reflection and total reflection, interference etc. Recognition of this analogy has been the cause of rapid progress in the study of the propagation of sea waves in the last few years by merely applying what has long been known about the laws governing light waves. Not all the concepts of Optics, however, have been utilised in the study of sea waves. This is particularly the case with the considerable amount of information available on the effect of prisms and lenses on the propagation of light.

In the present article, the possibilities are discussed of building submerged dams, or raised areas on the sea bed, having in plan the shapes of lens or prism sections to promote the concentration or the dispersal of the energy of sea waves just as lenses or prisms do with light waves.

It is common practice to denote by "wave orthogonals" the lines which define the direction of propagation of the waves and which are at right angles to the wave crests. In the study of sea waves these orthogonals can be treated in the same way as light rays in Optics.

As is known, the velocity of propagation of sea waves depends partly on the depth of water. It can be evaluated by means of the equation

$$C = \sqrt{\frac{gL}{2\pi} \tanh \frac{2\pi D}{L}}$$

where D = depth of water
L = length of wave

Consider the orthogonal of a wave with velocity C_1 which slows down to C_2 as a result of a decrease in the depth of water.

As in Optics, the orthogonal, i.e., the direction of the wave travel, will be deviated according to Snell's Law

$$\frac{C_1}{C_2} = \frac{\sin i}{\sin r} \qquad \text{(Fig. 1)}$$

*Based on an article published in the Portuguese journal "Tecnica," No. 283, June, 1958.

In this expression the ratio C_1/C_2 corresponds to the refractive index in Optics. When the wave travels from deep water into shallow water, its velocity decreases so that C_2 is less than C_1 and the ratio is more than unity.

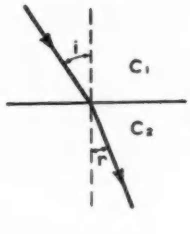


Fig. 1

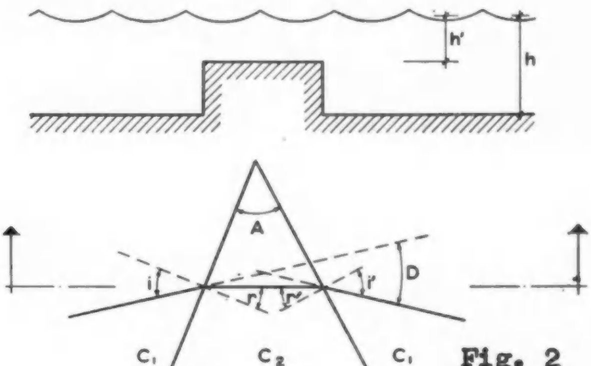


Fig. 2

The waves then deviate in the same way as light waves deviate when they pass from air into glass.

Table I shows the ratios C_1/C_2 for waves of different lengths passing from water of various depths into a shallow area of depth 15 metres.

If a submerged dam or raised area on the sea bed be built shaped in plan like a prism, a wave travelling across it will undergo two deviations, one when entering the prism and one when leaving it, just as with a light ray passing right through a prism of glass. (Fig. 2).

In a similar way submerged dams could be built having in plan the shape of a lens and thereby affecting the wave orthogonals precisely as glass lenses affect light rays.

Table II presents examples of this double deviation of waves of different lengths passing from a depth of 25 metres into a shallow area of 10 metres shaped in the form of a prism of various angles and leaving 15 metres clearance for ship traffic.

To protect these submerged dams against the wave action the structure should be kept well below low tide level. This would detract from their effectiveness at high water, but would enable lighter materials to be used and would also afford a better clearance to shipping.

A few possible examples of the use of submerged dams are set out below:

(a) **Protection of Harbour Entrances**

The selection of the proper width for harbour entrances is in most cases a compromise between two factors, viz.: they should be wide enough to let ships pass safely and easily, and they should be narrow enough to minimise the entrance of waves into the harbour. It may be expected that, if the direction of the wave

TABLE I

Water depth feet (m)	Wave length			
	328' (100m)	656' (200m)	984' (300m)	1.312' (400m)
57.4 (17,5)	1.05	1.06	1.07	1.07
65.6 (20,0)	1.09	1.12	1.13	1.14
73.8 (22,5)	1.12	1.17	1.19	1.20
82.0 (25,0)	1.14	1.22	1.24	1.26
90.2 (27,5)	1.16	1.26	1.29	1.31
98.4 (30,0)	1.17	1.29	1.34	1.36
106.6 (32,5)	1.19	1.33	1.38	1.40
114.8 (35,0)	1.20	1.36	1.41	1.44

TABLE II

Prism angles	Deviations	Wave length			
		328' (100m)	656' (200m)	984' (300m)	1.312' (400m)
10°	min.	1°20'	2°20'	2°20'	2°40'
	Max.	17°00'	20°10'	21°00'	21°30'
20°	min.	3°00'	4°40'	5°10'	5°20'
	Max.	21°10'	25°20'	26°30'	27°10'
30°	min.	4°00'	7°10'	7°40'	8°00'
	Max.	23°40'	28°40'	30°00'	30°50'
40°	min.	6°00'	9°20'	10°20'	10°40'
	Max.	25°30'	31°20'	33°00'	33°40'
50°	min.	7°40'	12°00'	13°20'	14°00'
	Max.	27°10'	33°30'	35°20'	36°20'

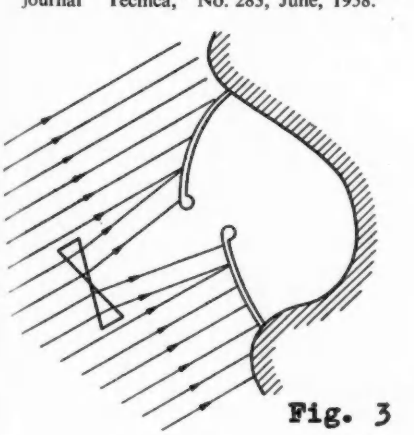


Fig. 3

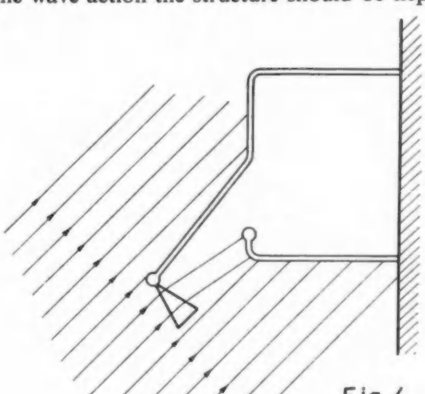


Fig. 4

Modification of the Sea Bed—continued

travel is known, the use of submerged dams would allow wider entrances to be adopted. (Figs. 3 and 4)

It should be noted that this type of submerged structure may be built right in front of the harbour entrance; since the upper level of prism is well below the water surface it does not cause wave breaking and allows ships to pass freely.

(b) **Improvement of Wave Conditions in Docks**

Waves can enter docks only if they come from one specific direction, namely, along the line joining the harbour and dock entrances. The submerged dams would in this instance prove particularly effective and simple. (Fig. 5).

(c) **Shore Protection**

Shore protection is generally effected by means of structures to prevent erosion by waves. The use of submerged dams designed specially to control erosion and accretion may be expected to show economies in shore protection.

(d) **Wave Breaking**

Lens-shaped submerged dams at a suitable distance from the coast, may be constructed so as to concentrate the energy of the waves to such an extent that they become unstable and thereby break. (Fig. 6).

Since these submerged dams, unlike breakwaters, are not exposed to the impact of the waves that they break, it would be possible to use lighter and cheaper materials for their construction.

(e) **Installations for Harnessing Wave Energy**

One of the main parts of this type of installation is the energy-concentrating dihedral. It may be expected that the construction of submerged dams in front of the dihedrals would considerably improve their efficiency or, alternatively, would allow their length and thereby their cost to be reduced without lowering their performance.

Being built at depths at which the orbital motion of the water particles is of small amplitude and low velocity, the submerged dams could be made of materials much lighter than those used in the construction of breakwaters. A few types of submerged dams are suggested in Fig. 7.

By combining a raised prism with a depressed one adjacent to it, a considerable saving in cost may be expected, provided that the materials dredged from the depressed area can be used for building the raised area. (Fig. 8).

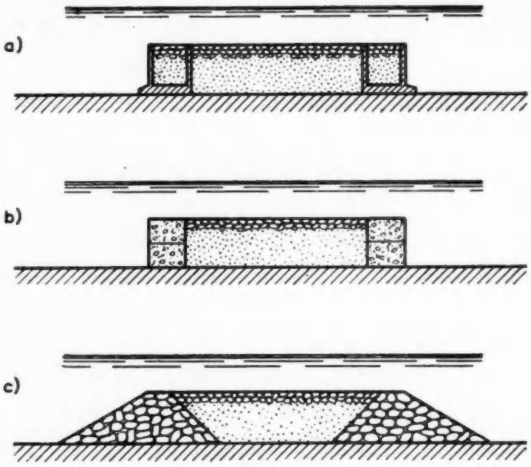


Fig. 7

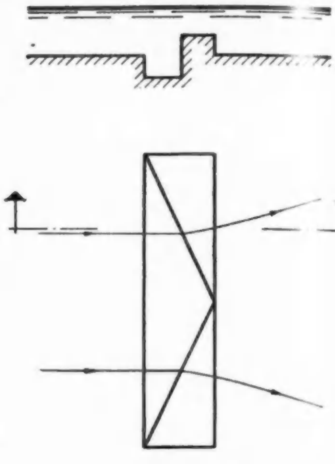


Fig. 8

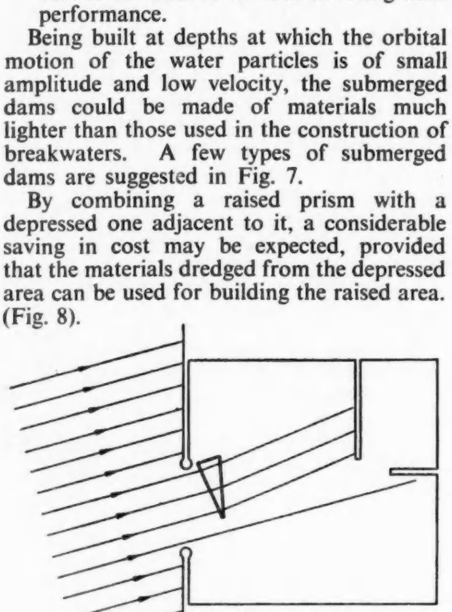


Fig. 5

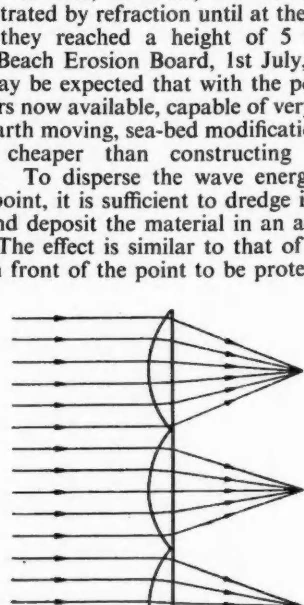


Fig.6

The shapes and sizes of the submerged dams required to deviate waves of some hundreds of yards in length still needs to be clarified, and this is likely to be possible only by the help of laboratory and full scale tests.

The dispersal and concentration of wave energy can be achieved not only by means of submerged prism or lens shaped structures, but in a more general way by suitably modifying the sea bed. This may be done either by dredging or by underwater filling, depending on the contours of the existing sea bed and of the specific results required.

In some cases Nature itself has so shaped the sea bed as to deviate the waves just as do with light rays.

This occurred to a breakwater at Long Beach, California, which was destroyed by waves that were not visible from the shore because their height was only one metre and their length 600 metres. Due to the contours of the sea bed, however, the waves were concentrated by refraction until at the breakwater they reached a height of 5 metres. (Bull, Beach Erosion Board, 1st July, 1950).

It may be expected that with the powerful dredgers now available, capable of very large-scale earth moving, sea-bed modification may prove cheaper than constructing breakwaters. To disperse the wave energy at a given point, it is sufficient to dredge in front of it and deposit the material in an adjacent area. The effect is similar to that of prisms built in front of the point to be protected.

The present technique of drawing wave orthogonals is accurate enough to design corrections to the sea bed with confidence that the results expected will be achieved.

Port Improvements in Japan

It was recently announced in Japan that the Government has voted the sum of 14,827 million yen in the 1959 fiscal year beginning in April, for harbour improvements. This is part of their seven year harbour improvements programme started in 1956 and the new allowance is an increase of almost 50 per cent. on the 1958/1959 figure.

Harbour improvements have so far been concentrated on the 17 major ports, and dredging is being undertaken at these ports and also the smaller ones to deepen them from 7.5 metres to an average of at least nine metres. The Ministry of Transportation recently set up a special committee to speed up improvements at these ports and the Ministry of Finance has agreed to allocate a special fund of 3,146 million yen to accelerate the work.

Other works at the major ports include, constructing new piers, installing modern cranes and other cargo handling facilities and building new sheds and warehouses. It is estimated that these improvements will save some 14,000 million yen annually in stevedoring expenses, and that a considerable saving will also be shown in the time needed to load or unload cargoes.

The strait between Moji and Shimonoseki will be dredged to at least 10 metres, so as to facilitate the passage of larger ships. The major ports used by tankers, will be dredged to 12 metres and bigger piers will be constructed to accommodate tankers of 40,000 tons d.w. or over.

New Gulf of St. Lawrence Port

A deep water harbour is to be constructed in the Gulf of St. Lawrence at Port Cartier 300 miles north-east of Quebec. The contract has been awarded by the Quebec Cartier Mining Co., which is developing iron ore deposits near Lake Jeannine, 200 miles north of Port Cartier.

Smoke Emission from Vessels

With particular reference to the Port of Manchester *

By G. E. STANLEY, M.A.P.H.I.
(Port Health Inspector, Manchester Port Health Authority)

BY 1850 major shipping companies were operating steamships all over the world, gradually lessening the use of sail. So with progress came the problem of smoke pollution from vessels in our ports. Responsible persons took notice and local acts were passed in London (1853) and Liverpool (1854), the first legislation made to control steamship smoke, just 105 years ago.

Public health legislation advanced greatly with the introduction of the Public Health Act of 1875. Constitution of port sanitary authorities was authorised and power given to take proceedings against the master of any specified vessel " lying in " a port causing a nuisance by sending forth black smoke. The powers were weak but at least a step on a national level had been taken.

Early in the 20th century two important developments occurred in the propulsion of ships that were to have a definite impact on the problem of smoke. In 1910 the first ocean-going motorship appeared. The diesel engine captured the interest of shipowners and soon became a serious rival to the well-established steam reciprocating engine. After World War I the second development took shape and oil commenced to displace coal as a marine fuel. Its ease of use, handling and storage proved a great advantage over solid fuel, and its popularity soon justified the claims put forward. Engineering genius coupled with scientific and technical research had provided a valuable aid to assist legal enactments in the struggle to reduce smoke. Unfortunately the Public Health (Smoke Abatement) Act, 1926, did little to provide more power to control vessels. It exempted any ship habitually used as a seagoing ship and only allowed the provisions of previous enactments in force to apply, i.e., Public Health Act, 1875, and local enactments.

No further national legislation was passed until the Public Health Act, 1936, whose provisions covered shipping up to May 31st, 1958. Section 267 of the 1936 Act applied certain provisions, including smoke nuisances to vessels lying in any inland or coastal waters as if the vessel were building, and the master or person in charge were the occupier.

Proceedings could, however, only be taken against any non-sea-going vessel emitting smoke (shade not specified), or sea-going vessel emitting black smoke, both in such quantities as to be nuisances, but only when the vessel was " lying in ". Vessels under way were outside the scope of the Act. The meticulous procedure in connection with statutory nuisances is well known and is entirely unsuited for vessels.

Bearing in mind these restrictions, port health authorities seldom used the Act and have had to rely mainly on informal action to stop offending vessels.

THE PORT OF MANCHESTER

The Manchester Ship Canal was opened to traffic on January 1st, 1894. This great event converted an inland city into a port destined to rank as Britain's third in importance when judged by the volume of trade. The canal ensured the survival of Manchester as a leading industrial centre and opened her markets to world trade.

The port is situated in and serves the most densely populated district in England. It extends from Eastham in Cheshire up through the canal to the terminal docks in Manchester, Salford and Stretford, a total distance of $35\frac{1}{2}$ miles. The Ship Canal passes through agricultural, suburban and industrial areas within or abutting the boundaries of fifteen local authorities, and gives access to all docks and berths with the exception of Widnes and the Queen Elizabeth II Dock. Both these docks are entered from the River Mersey, the latter being opened to tanker traffic as recently as 1954.

Size of vessels that can navigate the canal is governed by the dimensions of the locks, bridges and draught on arrival. When necessary the tops of masts and funnels must be reduced to 70-ft. above the water line to clear the fixed bridges. The excavated width of the canal varies from 90 to 180-ft.

The rise in importance in only 64 years may be gauged from the following figures. In 1894, the first year, cargo tonnage amounted to 925,659, increasing to a record 18,563,376 tons in 1955. Cargoes of every description, including foodstuffs, are handled, with oil contributing largely to the tonnage. In 1957, 2,363 vessels from foreign ports and 3,270 trading coastwise entered the port, a total of 5,622 vessels. In addition, there was also a considerable amount of local traffic between the port and outside districts.

Such is the thriving port of Manchester, England, and providing a difficult problem in smoke control in respect of moving vessels.

Manchester Port Health Authority

The Manchester Port Sanitary Authority was constituted by an Order of the Local Government Board dated September 4th, 1896. Under the Public Health Act, 1936, its title was changed to the Manchester Port Health Authority. The constitution of the Authority is made up by fifteen local authorities whose districts abut on to the port. All authorities are represented by elected members.

Under the Appointment of the Port of Manchester Order, 1956, made under the Customs and Excise Act, 1952, the port includes the Manchester Ship Canal, the Queen Elizabeth II Dock, Eastham, the navigable part of the River Mersey above Ince Ferry and Dungeon Point, the navigable part of the River Irwell, and the River Weaver as far as Frodsham Bridge, with all channels, havens, streams, creeks, cuts and docks within such limits.

The Authority's jurisdiction covers the whole of the port but only in respect of vessels.

Normally the inspectorate consists of two food, three port health and one student inspector. All are responsible to the Port Medical Officer of Health regarding their duties, there being no chief inspector. No specialised smoke inspector is employed and smoke control comes within the routine duties of the port health inspectors. Two of these inspectors are based at the Salford office and cover the port as far as Latchford Locks, their means of conveyance being by train, bus or cycle. The third, based at Runcorn, works from Latchford to Eastham, having at his disposal the launch " Hygeia " and the assistance of the student inspector.

Smoke Control in the Port

The daily average of mechanically propelled vessels in transit has been estimated at the following points to be—Eastham Locks 70 to 80, Stanlow 50 to 60, Latchford Locks 25 to 30. Vessels alongside from foreign and coastwise ports average about 50, and altogether it is considered that up to 150 vessels of all descriptions, with boiler plant, are present in the port every day, roughly half being in transit. Experience has shown that about 35 to 45 vessels are daily liable to emit excessive smoke.

The range of vessels using the port is diverse and includes cargo liners, tramps, tankers of every description, short sea traders and coasters. Engaged in local trade and harbour duties are found hoppers, canal boats, barges, tugs, dredgers, grain elevators and floating cranes. All have boiler plant, although not necessarily for propulsion.

The above may be divided into two main categories—(i) steam vessels burning coal or oil, (ii) motor or diesel vessels.

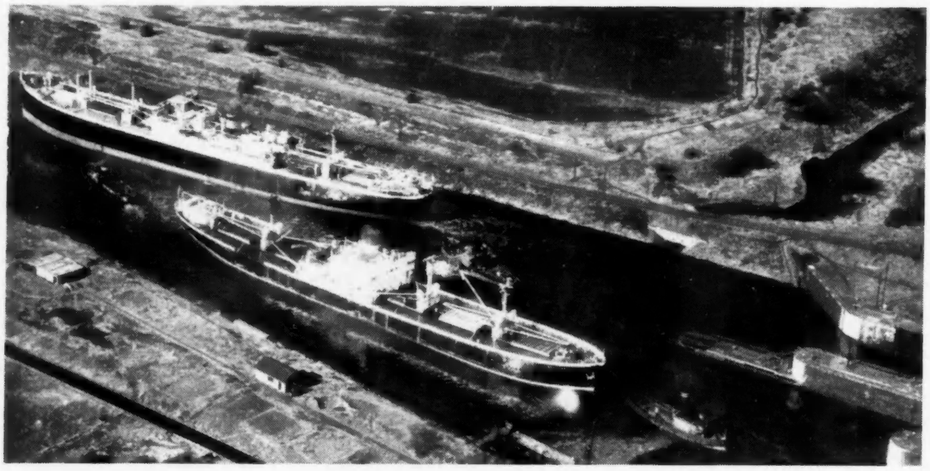
Vessels Alongside

In the case of vessels tied up, supervision is easy providing accessibility is quick and an inspector happens to be on the spot at the right time. Emissions caused by human element failure are usually quickly remedied by verbal representation but difficulty arises when boiler plant is defective and cannot be corrected by those in charge.

Whilst cargo vessels are not immune, the greatest concern has been caused by tankers discharging cargo with their own steam pumps. In September, 1955, a petition was received from residents in the vicinity of the

* Abstracts of a Paper read before the 65th Annual Conference of the Association of Public Health Inspectors at Blackpool, September, 1958.

Smoke Emission from Vessels—continued



Ship manoeuvre in Manchester Ship Canal.

new Queen Elizabeth II Dock complaining of smoke nuisance from tankers. Consultation took place between the Bebington Corporation and the Port Health Authority and it was decided that in the event of any tanker emitting black smoke so as to be a nuisance, speedy joint action be taken by both authorities under the Public Health Act, 1936. Unfortunately the need to take legal proceedings and test the Act has not arisen, although over 800 foreign-going tankers have since entered this dock. In this case it is curious that legal action would have to depend on an easterly wind blowing black smoke into houses. The prevailing wind is westerly !

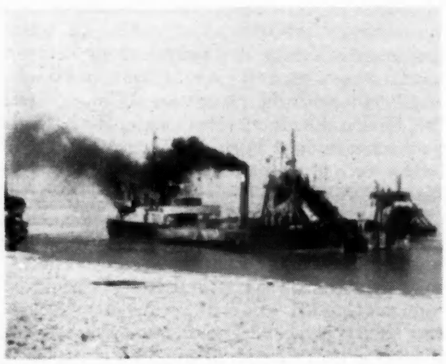
Vessels Under Way

Smoke from vessels proceeding along the canal presents the most serious problem. The chief offenders are the aged smaller vessels, i.e., coasters, hoppers, tugs, barges, canal boats and dredgers. These craft are fitted with hand-fired natural draught coal boilers, sometimes poorly maintained, manned by inexperienced or careless firemen using unsuitable coal. One cause of smoke from these vessels is due to the fireman still adhering to the practice of pitching at long intervals.

Oil-fired vessels in transit are occasional smoke offenders but as with all moving vessels no positive action can be taken at the time except observation and verbal communication. In the case of large ships the matter is taken up when the ship has docked.

The practice of towing ships along the canal with two tugs, one ahead and the other astern, is necessary because of the narrow channel. In passages lasting up to eight hours, during which other ships have to be passed, locks negotiated, and possible weather hazards encountered, the task of these tugs is not easy and a great strain is placed on the crews. Fortunately two-thirds of the towage tugs belonging to the Manchester Ship Canal Company are diesel driven and it is hoped that eventually all coal burners will be dispensed with.

In September, 1956, a second petition signed by 119 residents of the Walton and Stockton Heath areas was forwarded to the Authority by the Runcorn Rural District Council. This petition strongly protested



Dredger at work loading hopper.

against the practice of passing ships emitting smoke and affecting private houses. Vessels under way being exempt under the Public Health Act, 1936, inspectors could only continue their practice of observation followed up by written or verbal representation to owners and crews.

Publicity and Education

Since the advent of a more rigorous clean air policy in this country and the awakening of public opinion, as evidenced locally by the two petitions, the Manchester Port Health Authority has endeavoured to publicise at every opportunity the necessity of stricter smoke control on vessels.

Letters have been sent to all the British and foreign owned shipping companies whose ships offended whilst using the port and their co-operation and interest earnestly requested.

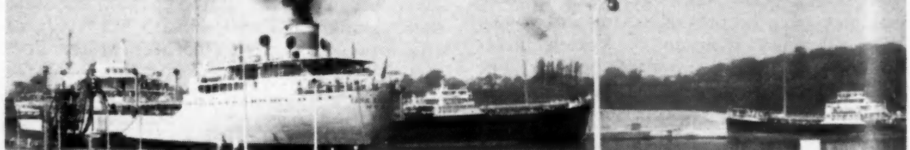
Owners of local craft have been communicated with again and again in an effort to bring about an improvement, whilst the Steamship Owner's Association in Liverpool and Manchester have been requested to give their interest and assistance.

Observations on Vessels

In the recording of accurate smoke observations the following points are essential—(i) the top of the funnel must be visible against a clear sky; (ii) the observer should be positioned to watch smoke blowing across the line of vision; (iii) care must be taken to allow for existing light and to avoid effect of the sun on the smoke shade.

In respect of vessels alongside it is not always possible to satisfy these requirements. In crowded dock systems, observations may be impeded by sheds, cranes or other vessels, and the observer have difficulty in obtaining a suitable vantage point.

With moving vessels the position is even more complicated. On a wide open waterway observation is possible from the shore providing conditions are favourable and the vessel can be kept in view at a reasonable distance for the requisite time period. Doubt is cast on the approval of binoculars for this purpose. In narrow waters like the Ship Canal vessels soon pass a fixed point, and unless an observer is mobile, observations are of short duration. Mobility and clear



Tanker smoke—Queen Elizabeth II Dock, Eastham (Manchester Ship Canal).

Smoke Emission from Vessels—continued

observations are often obstructed by the terrain, dockside buildings and the lack of roads. It is also questionable whether a court would accept an observation taken partly from a moving cycle or vehicle. Observation from a launch keeping a steady distance ahead or astern of the suspected vessel has advantages but consideration must be given to navigation, speed requirements, intrusion of other vessels, sun position, course changes and angle of smoke plume. Experience gained in observations from the Authoritys' launch "Hygeia" has often proved that crews of local vessels are soon aware of the intent and quickly reduce smoke.

The use of a Ringelmann Chart to observe moving funnels is impracticable unless the observer is actually on the observed ship. The Micro-Ringelmann viewer, however, has been found suitable, although doubts have been expressed of its consistency.

Whilst observations can be carried out and smoke densities memorised with experience, due appreciation of the difficulties should be realised by all concerned.

THE CLEAN AIR ACT, 1956

(a) Application to Vessels

The Clean Air Act, 1956 (Appointed Day), Order, 1958, brought into operation on June 1st, 1958, the provisions relating to the prohibition of dark smoke from chimneys and the application of the Act to vessels. Section 31 (2) ensures that port health authorities which have powers and functions to deal with smoke nuisances under the Public Health Act, 1936, are to assume corresponding powers under the new Act. Sections 101 to 106 of the Public Health Act, 1936, are repealed as well as the proviso to Sub-section 4 of Section 267 concerning the emission of black smoke from sea-going vessels. Under Section 1 (2) of the Clean Act the Minister of Housing and Local Government is empowered to make regulations to prescribe the permitted limits for emissions of dark smoke from vessels.

Under Section 20 (1) of the Act it is clearly laid down that only Sections 1 and 2 shall apply to vessels in certain waters as they apply to buildings. The owner of, and the master or other officer or person in charge of the vessel, is regarded as the occupier. References to a furnace includes references to an engine of a vessel. With regard to this last reference it is assumed that engine includes any boiler plant used for auxiliary purposes not connected with the main engines.

Section 20 (2) states that the local authority whose district includes that point on land which is nearest to the position of the vessel will be responsible for administering the legislation. It is, however, necessary to bring in Section 31 (4) at this point, which states that a port health quthority will be the controlling authority as far as its functions under the Act extend. Thus is avoided any possibility of a local authority and a port health authority overlapping in carrying out their obligations. In Manchester this clarification of responsibility is important owing to the number of local authorities whose districts abut the waters of the port. Section 31 (1) also confers powers of entry in relation to any vessel in accordance with the Third Schedule, Part I, to the Clean Air Act. Section 29 (2) will allow a local authority to institute proceedings in the case of dark smoke from a chimney outside their district whilst Section 16 provides for smoke nuisances. The use of these powers in respect of vessels is problematical and should not arise.

Natural draught—coal and oil fuel.

Vessels and dwelling houses, Stockton Health and Walton (Manchester Ship Canal).

Returning to Section 20, Sub-section 3 defines the waters applicable to the section and gives the meaning of the charges in respect of these waters. This subsection requires serious consideration to ascertain that charges other than the exemptions are empowered and thus ensure the waters of a port come within the Act. Sub-section 4 of Section 20 is an important saving clause. It states simply, "save as provided in this section nothing in this Act applies to smoke, grit, or dust from any vessel". An apparently straightforward clause, but far reaching as except for Sections 1 and 2 it plainly divorces a part of the Act from vessels. For instance, Section 11, dealing with smoke control areas, will not include vessels which are treated in the same way as railway engines and both are exempt from control.

The desirability of establishing smoke control areas in a port district under the control of a port health authority is, however, covered by Section 31 (4), but it is assumed that control will only apply to the chimneys of dock premises and buildings on land. The Manchester Port Health Authority has no jurisdiction over land or buildings and will therefore not be able to exercise this right.

Before leaving Section 20 attention is drawn to Section 22, Sub-sections 1 (d) and 3. The latter applies Section 20 to vessels owned by the Crown, but not to vessels of Her Majesty's Navy or to Government ships in the service of the Admiralty for the purposes of Her Majesty's Navy. Examples of vessels owned by the Crown are cable ships and fishery protection vessels, operated by Government departments. It is opined that Section 20 will cover Royal Fleet Auxiliaries such as tankers when engaged in ordinary commercial trade. Sub-section 1 (d) lays down the procedure of reporting to the Admiralty, as representing the responsible Minister, any cases of dark smoke emission from vessels of Her Majesty's Navy or Government vessels employed by the Navy.

Having endeavoured to establish the application of the Act to vessels and define the duties of port health authorities, attention is now given to Sections 1 and 2.

(b) Defences

Under Section 1 (1) and (2) it will be an offence (subject to provisions and regulations) for dark smoke to be emitted on any day from a chimney (funnel) of any vessel. Section 34 defines chimney as including structures and openings of any kind from or through which smoke may be emitted. The same section defines dark smoke as "smoke as dark or darker than shade 2 on the Ringelmann Chart".

The defences given in Section 1 are wide and it is desired to make the following observations.

It is considered that a defence due to the lighting of a cold furnace is reasonable. Defence to prove a failure of a furnace or its associated apparatus will, however, be extremely difficult to overcome, particularly if a vessel is under way at the time of an observation and cannot be visited shortly afterwards. It may be argued that some mechanical defect did take place and was remedied as soon as possible, in which case refutation of the defence could not be made.

In the case of vessels trading regularly in a port a good knowledge of the boiler plant can be obtained if sufficient time is devoted to smoke pollution duties. With foreign-going or irregular trading vessels, however, the position is different. Such vessels may only stay two to three days in port and not

Smoke Emission from Vessels—continued

be seen again for years so little opportunity is available to familiarise oneself with their design and steam raising plant. The boiler equipment in modern vessels, particularly tankers, has tended to become extremely complicated in design and instrumentation, whilst combustion controlled by automatic devices is becoming common. Expert advice is often sought when a defect occurs and in some cases this can only be obtained from the manufacturers of the equipment concerned. Mechanical breakdown defences may therefore cause considerable difficulty unless specialist knowledge can be countered likewise. Port health inspectors may not possess a really good knowledge of combustion technique, their past duties have been mainly concerned with other aspects of public health work, and only the odd one or two have been marine engineers. It will, therefore, be realised that in the event of legal proceedings they may be in a difficult position to refute technical evidence submitted by the defence which is substantiated by persons holding specialised qualifications in this sphere.

The use of unsuitable fuel as a defence needs most serious consideration. The word unsuitable has a wide meaning, and is bound to lead to arguments, leaving a trail of volatile contents, classifications, size and viscosity grades in their wake.

Generally speaking the suitability of fuel oils depends on whether the oil-burning equipment is of the right type. Marine fuel oil has today, by diligent research by the major oil companies, reached a high stage of perfection, and makers of oil-burning equipment have kept in step in improving their products.

The word " practicable " is defined in the Act as meaning reasonably practicable having regard amongst other things to local conditions and circumstances, to the financial implications and to the current state of technical knowledge, and " practicable means " includes the provision of maintenance of plant. The definitions throw open a very large field of conjecture. Taking it briefly, local conditions and circumstances in respect of shipping may be said to bring in aspects of weather, tides and, what is most important, safety of navigation and manoeuvring in congested and narrow waters. The application of financial implications is not clear, but tempts one to ask if it covers an owner of a vessel who, owing to a trade recession with associated low freights, is forced to buy inferior fuels and keep maintenance costs to a bare minimum in order to keep his vessel trading, with smoke emission the last thing to be considered.

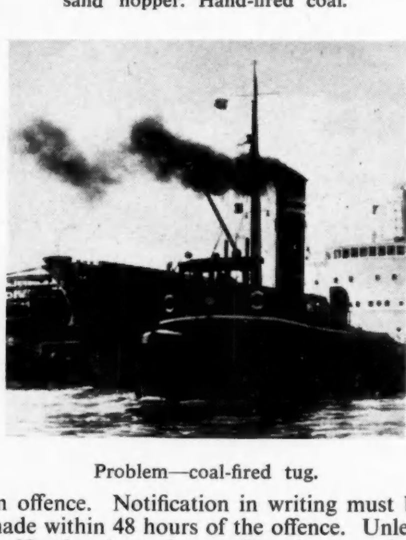
Section 2 provides further defence concerning contraventions—(a) due to the nature of a building (vessel) or its equipment and not to failure to properly maintain and use, and (b) that it had not been practicable to alter or equip the vessel so as to avoid contravention. Sub-sections 2 and 3 cover the issue of certificates by local authorities in this respect. At the end of seven years from 1956 such certificates cease when presumably owners and persons interested should have had time to be able to comply with Section 2.

There appears to be doubt as to whether vessels will be concerned under this section, and it will only be utilised in respect of shore installations and plants. It will be seen, therefore, that the defences outlined in the Act are strong. It will behove port health authorities to be extremely cautious and very certain before proceedings are taken.

(c) Notification of Offences and Penalties

Section 30 lays down the procedure of notifying the owner or master or other officer or person in charge of a vessel in regard to

Persistent offender type—aged steam-driven sand hopper. Hand-fired coal.



Problem—coal-fired tug.

an offence. Notification in writing must be made within 48 hours of the offence. Unless notification is made speedily, the procedure may, in certain cases, fall down and most certainly in respect of outward-bound vessels. Similarly the serving of a summons prior to proceedings against a foreign-going ship will need very prompt attantion and take place before the master leaves port. Otherwise successful service will depend on contacting the master at a future date.

A person (master) found guilty of an offence is liable to a fine of up to £100 (Section 27). The efficacy of the penalty will depend on the type of vessel and company involved.

The foregoing criticisms are given in good faith but no one must minimise the very great importance of the Act. For the first time in over 150 years national legislation has been introduced to deal more adequately with smoke pollution by vessels and a tremendous step forward has been taken.

Conclusions

The object of securing clean air in our ports is not going to be easily or cheaply accomplished. A quick attainment is desired, but even under new legislation progress is likely to be steady rather than spectacular. Prosecutions will doubtless be taken and have their effect, but the main duty will be endeavouring to convince, educate and obtain the full co-operation of all concerned. The task is great and forms an integral part in the national aim. It is significant that in a questionnaire returned to Gilpin (1957) by 211 local authorities, 13 indicated that the source of their most serious form of pollution was from shipping, and this source was placed eighth in importance out of fifty others. It is submitted that this high ranking is chiefly due to the still large numbers of British owned coal-fired vessels operating in coastal and estuarial trades, and on harbour duties in home waters. It is this sphere that offers the sternest challenge, and one that should be given high priority.

In furtherance of the campaign the following observations are put forward for consideration:—

(i) Training of Personnel

The general standard of efficiency in stoking methods in our coal-fired vessels is unsatisfactory and requires raising. The existing pre-sea training schools run by the Shipping Federation for Merchant Navy boiler room ratings do excellent work with limited facilities and their instructors are to be commended. These courses of three weeks' duration include instruction in smoke abatement and every effort is made to stress its importance. Unfortunately these schools do not cater for the training of personnel engaged on local craft, although no doubt some men may have passed through the course in the past. Admittedly the training of these local men is not easy of accomplishment owing to their constant movement and uncertain hours of work, not to mention their dislike of the classroom. It has been argued that engineers in charge should be capable of instruction to their staff, but is this solution adequate even if the engineers are always willing and capable ? The Manchester Ship Canal Company and other owners have shown deep concern in the matter and have obtained the advice of the National Industrial Fuel Efficiency Service, resulting in personnel being shown economical firing techniques. These efforts, valuable as they are, do not, however, ensure adequate training of all boiler plant operatives on local coal burners, where casual labour is often employed and the need is greatest.

Serious thought should therefore be given

Smoke Emission from Vessels—continued

to this problem in an effort to raise the quality and status of the men. It is suggested that a scheme could be provided on the lines of the one provided by the Shipping Federation, or even incorporated into an extended Federation organisation. It is also recommended that reference be included in the curriculum of subjects taken by both deck and engineering candidates studying for certificates of competency as issued by the Ministry of Transport.

(ii) **Suitability of Fuel**

This question can be associated with that of training, the higher the standard of firemen the better they are able to cope with poor fuel. As previously mentioned, the quality of fuel oil grades is satisfactory and smokeless combustion will result if all necessary conditions of boiler equipment and maintenance are complied with.

The suitability of coal depends on such factors as size grading, caking and coking qualities, ash content and calorific value, combined with the method of firing, available draught and load on the boiler. Unfortunately the national output includes only a small percentage of low volatile grades and the demand far exceeds supply. In the north-west area marine bunker supplies are usually of high volatile content, vary considerably in size and require expert usage. Consequently the users have to obtain the best results possible from their allocations. Under these circumstances it is impossible to lay down in regulations a standard of coal and it will presumably be left to the courts to decide a standard in cases where unsuitable coal is put forward as a defence.

It is felt that the allocation of the best available coals to marine users is of paramount importance and every effort should be made to ascertain whether the present system can be improved.

(iii) **Instrumentation and Aids**

In the newer oil-fired ship this aspect is improving and the following mainly concerns coal burners. It is agreed that instruments are necessary if efficient combustion is required and their proper use depends on the technical knowledge of the boiler operative. Improve technical knowledge and the proper use of instruments becomes feasible. Small vessels to-day are equipped with the bare minimum required by law, namely, pressure gauges and water level indicators, and it is not likely that owners will fit other instruments if their use is problematical. A better case can be made out for aids. The smoke eliminator door designed by the Department of Scientific and Industrial Research (Fuel Research Section) is an excellent device when used intelligently and should be fitted whenever possible. It has been fitted to several vessels in this area but regrettably some owners are against it on the grounds that the final results depend on the quality of coal and the human element.

Another valuable aid is the visual smoke detector, when a funnel cannot be seen from the firing platform. The periscope-type fitting using mirrors is especially beneficial and is recommended whenever suitable.

A solution—diesel tug.

(iv) **Inspectorate**

The task of enforcing smoke control on vessels falls mainly on port health inspectors, although in some cases their public health colleagues will also be implicated. The proper implementation of the Clean Air Act and Regulations will require increased time being spent on this work, much more than has been allotted in the past. Smoke enforcement in all its phases comes within the role of specialist inspectors and serious thought should be given to the training of existing staffs. Port health inspectors are advised and should be encouraged to take recognised smoke control courses and examinations. They will find certain of the study involved is far removed from ships but the basic principles are given and can be applied. Consideration should be given to the holding of short training courses by qualified lecturers; these could take the form of week-end study groups at selected places accessible to the different ports.

(v) **Regulations**

Every effort must be made to ensure the working of the new regulations and it is hoped all authorities will co-operate with each other to the fullest extent.

A proposal that the regulations should be permanently displayed in the boiler rooms of all British vessels has not met with unanimous agreement. The suggestion, however, is still adhered to as it is believed that such notices would be a constant reminder to those they mostly concern.

The foregoing recommendations are made in the firm belief that their fulfilment is necessary if smoke abolition within prescribed limits is to be successfully achieved in a comparatively short space of years. Failing their realisation it is my opinion that a satisfactory solution will only be reached by the complete changeover in fuel from coal to oil. This evolution is well established in large ships and is at last gaining momentum in the favour of small vessel owners. The maritime fuel scene changes. Coal struggles to survive against the ever-growing challenge of oil, whilst the application of nuclear power for ship propulsion has already achieved success.

The Dark Smoke (Permitted Periods) (Vessels) Regulations, 1958, came into force on June 1st, 1958. The Ministry of Housing and Local Government have indicated that initially local authorities should endeavour to explain the requirements of the Regulations to those concerned and seek their co-operation before strict enforcement is carried out. The diversity of ships and nationalities involved make the request reasonable and will give both sides time to fully understand the position.

Reference to the Regulations at this stage must necessarily be brief. Whilst the permitted periods in respect of oil-fired vessels are considered satisfactory, it is felt that those covering coal burners will be severely criticised. These vessels are the chief problem and it is hard to realise the fact that with a permitted period of 20 minutes aggregate in the hour, such a vessel may emit dark smoke for one-third of the time taken for a passage, say, along the Manchester Ship Canal. A further weakness is seen in the operative lengths of time, i.e., two hours in Class 1 vessels and one hour for the remainder, because difficulty will be experienced in continuous accurate observations of moving vessels for such periods. The prohibition of more than three minutes black smoke in the aggregate in 30 minutes is realistic and should help to restrict emission of smoke above Ringelmann shade 4.

The Regulations are not ideal, but at least improved powers of control are available after what must have been long and protracted discussions by those concerned.

Modern Methods for the Removal of Petroleum Pollution from Harbour Waters

The following summary is based on papers by J. G. Armstrong, Baurat Stehr, and M. de Wilde, which were presented at the Third International Harbour Congress held in Antwerp, June, 1958, under the auspices of the Royal Flemish Institution of Engineers. The descriptions of the equipment used at Hamburg and Antwerp are due to the two last-mentioned authors respectively.

Regulations made and enforced by Harbour Authorities and other responsible bodies have greatly reduced the hazard of harbour pollution by petroleum products, but the problem of their removal arises when accidents occur. The problem consists primarily in confining the results of oil spill to as small an area as possible by using cylindrical hinged fenders. Once this has been done, modern removal methods can be applied and the oil slick effectively dealt with.

For some time past, methods of surface oil removal using patented products have been tried out. These materials consist generally of graded fine sand which is first coated by mixing with a solution containing finely divided carbon, which adheres to the sand, and is then heat-treated or roasted in a kiln. This fine granular material is applied to the oil slick on the water surface by dusting or spreading. This operation is generally accomplished by hand, though an effective method in use at Falmouth incorporates a mechanical spreader mounted on the stem of a motor boat. On coming into contact with the oil, the material causes tar-like clusters and masses to form, which are slightly heavier than water and slowly sink. The sinking process is speeded up by agitation of the water. It is claimed that the oil cannot separate again and will not return to the surface. A drawback of this method is that the tar-like masses which have sunk possibly kill small forms of marine life and are thus harmful to the sea-food industry.

Equipment for removing surface oil slicks consists, in general, of a floating craft modified for the purpose and fitted with an open-type gravity separator or conversion unit separators, together with oil settling tanks, vacuum tanks, compressor and pump. In most cases fishtail collectors are mounted on the stem of the craft; alternatively, suction nozzles mounted on flexible hoses and slung from a derrick are used. In all cases, whatever the method used, a considerable proportion of water is lifted with the oil. The clean water discharged from the separators is continuously fed back to the harbour. The recovered oil is transferred to the settling tanks via the vacuum tanks where further dewatering takes place. This oil may be suitably processed and used for firing boiler furnaces; at certain ports it is handed over to the local oil refinery for treatment.

Method Adopted at Hamburg

A specially developed device for the removal of oil has been introduced at the Port of Hamburg. It consists essentially of a skimming tank with automatically regulated inlet openings. The tank is equipped with four floats which are positioned symmetrically around it. It is furthermore fitted with four flap-type inlet valves pivoted about bearings fixed to the framework of the floats. The oil and water mixture enters the tank through these inlets and is removed by pumping, the pump being installed on the attendant craft. The tank is so mounted as to have freedom of vertical movement in relation to the floats. In proportion as more oil and water flow into it, it will settle deeper into the water. This will cause the inlet valves to tilt up and thus to reduce and, in certain circumstances, temporarily to stop the influx into the tank. The tank can therefore never fill up beyond a certain level. In this way the amount of oil and water mixture entering the tank is automatically adjusted to the draw-off capacity of the pump that removes it from the tank, and a layer of water and oil of fairly constant thickness is skimmed from the surface of the water. This thickness can be altered within fine limits to suit the intensity of the oil pollution, adjustment being effected merely by appropriately varying the rate of discharge of the pump. The tank will thus adopt an equilibrium position suited to the prevailing conditions.

The overall dimensions of the experimental apparatus at present in use are 2.50 m. by 2.50 m. The cylindrical skimming tank is 0.82 m. in depth and has a diameter of 0.82 m., the inlet valves being 0.41 m. wide. It is intended subsequently to mount the pump on one of the floats and thus to make the skimming device self-contained.

Oil Removal at Antwerp

Up to 1954, oil pollution at the Port of Antwerp was removed by manual methods. This has been superseded by a mechanical floating installation consisting of a steel pontoon (10 m. x 4 m. x 2.20 m.) driven by a 20 h.p. outboard motor and equipped with a 30 h.p. combined vacuum pump and compressor unit, two 3,500-litre emulsifying tanks, an open decanting tank (or separator) of 20,000 litres capacity, and a 2½-in. diameter suction nozzle mounted in a collecting tank suspended in the water from the stem of the craft.

The oil and water mixture flows into the collecting tank, which is fitted with a set of screens to keep out floating solids, and is drawn off through the suction nozzle and passed to one of the emulsifying tanks, where under a partial vacuum the mixture is first converted into an emulsion and is then forced by compressed air to the decanting tank. The two emulsifying tanks work alternately. In the decanting tank the oil separates from the water and floats to the top, the water from the bottom of the tank being returned by siphons to the harbour. The thickness of the layer of oil in the decanting tank progressively increases, but even with an oil depth of as much as 1.50 m. almost complete separation is still achieved, and at least 15,000 litres of oil can be collected in the tank before it has to be emptied. This latter operation is nowadays effected by means of a special vehicle equipped with a 6,000-litre vacuum tank.

In 1955 this installation conclusively proved its worth by removing 27,000 litres of floating petrol in only 6½ hours; 136,500 litres of emulsion (petrol plus water) were pumped and decanted in the course of this operation. This represents an efficiency of 27,000/136,500 or approximately 1/5. It is rarely possible to achieve such a high efficiency, however, as the oil usually forms a viscous slick on the surface of the water and is mixed with floating dirt and driftwood, which make collection of the oil difficult and greatly reduce the efficiency factor, which in most cases is only of the order of 1/20 to 1/30.

Bristol Channel Radio Communications

Ilfracombe Radio, the new Post Office coast radio station at Mulacott Cross, North Devon, was opened last month. It is one of the most up to date of its kind in the world and is designed to improve the service and extend the range of ship-shore radio communication in the Bristol Channel area. For the past three years the short-range radio-telephone service for these waters has been operated from a temporary station at Ilfracombe Head Post Office, and this as well as the short-range radio telegraph service previously given through Burnham Radio will be taken over by Ilfracombe Radio.

Some ten million tons of foreign trade are handled in Bristol Channel ports annually, and between 75-100 ships are at sea in this area every day of the year. Traffic through the new station will include messages between shipowners and their ships at sea; crews and passengers to their friends on shore; assistance for ships in distress; and advice to ships' masters on medical treatment when their ship does not carry a doctor. In addition, ships at sea can receive weather bulletins, gale warnings, navigational warnings and a direction-finding service.

There are now 12 radio stations in the Post Office maritime radio communication service. The largest is Burnham Radio and it serves ships at sea in any part of the world. The remaining stations provide communication up to about 300 miles off the coast of Britain.

As is the case with other coast stations, Ilfracombe Radio can connect ships' radio-telephones with the inland telephone network so that the subscribers can speak direct to their friends at sea. There are now over 100,000 of these calls every year.

Modern Applications of Steel Sheet Piling

By L. DESCANS
(Honorary Chief Engineer of Bridges and Roadways, Belgium).

(*Continued from page 279*)

Sections and Jaw Connections of Sheet Piling

Steel sheet piling sections are, as a rule, of two types " Z " or " U " (see Fig. 18). In the case of the former the connections between two elements are on the outer faces of the wall, whereas for the " U " section, the jaws are on the neutral axis.

Manufacturers' catalogues give figures which state the section modulus of the corrugated wall as related to the neutral axis "XX." For usual sections of 20—30 cm. (8—12-in.) total depth of corrugation, these moduli vary between approximately 1,200 and 3,000 cm.^{3} per meter (22 and 56-in.^{3} per foot) length of wall and if the admissible working stress of the steel is limited to 0.5 or 0.6 times its own elastic limit, the moment of resistance of a wall of the usual type can vary as between 20 and 60, or even 75 tm/metre (530 and 1,600 or even 2,000 kips in. per foot) of length. Thus, subject to the conditions of exterior loading, it is possible to construct walls of sheet piling of up to 10—12 metres (33—40-ft.) in height.

For " Z " section piling, the **actual section modulus** corresponds exactly with the theoretical value given in the makers' catalogues. This does not pertain, however, in the case of " U " section piling, unless the connecting jaws have been wedged or fixed in such a manner as to prevent any slip between one element and another, due to the effect of shearing efforts.

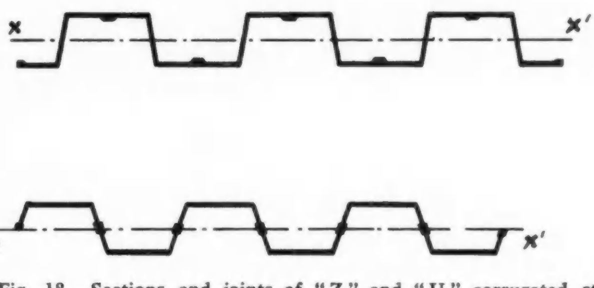


Fig. 18. Sections and joints of " Z " and " U " corrugated steel sheet piling.

Slippage between elements is sometimes facilitated by the fact that the driving team has been tempted to grease the connecting jaws with a view to render driving easier. On the other hand, however, slip will be braked, to some extent, if the jaws wedge themselves during driving, or as they gradually become rusty. It is, however, prudent to follow advice given, notably by Professor Terzaghi in his paper " Anchored Bulkheads," and not to consider such favourable conditions as being present, for complete freedom to slip as between jaws in a sheet piling wall of " U " section, can reduce the theoretical section modulus of this by as much as 40—50%.

The watertightness of a wall is of great importance, preventing as it does any loss of particles of earth which may be carried through the joints by water, where the earth bank or fill behind the wall has been completely saturated, as would be the case after heavy or tropical rains, or by submersion of the surrounding earth due to flooding.

Each succeeding element of a " Z " piling wall is subjected to some deflection from the normal line of pressure by reason of the oblique angle as between the axis of the wall and the axis of minimum moment of inertia of the single pile (Fig. 19). This causes traction as between the outer interlocks and wedging of the inners thus tightening the joints between elements and serving to render these watertight.

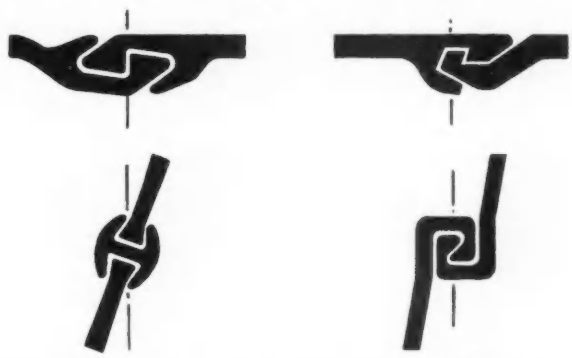
A series of steel piles (double T or box sections) or a combination of box piles and normal sheet piling sections (Fig. 20) can form a wall with a large moment of resistance*. With widths of wall of from 60 to 100 cm. (24—40-in.), it is possible to obtain section moduli of from 3,000 cm.^{3}/m. to 14,000 cm.^{3}/m. (56-in.^{3}/ft.—220-in.^{3}/ft.) which can fully meet moments of 60—350 tm/metre (1,600—9,250 lb. in./ft.).

Flat sheet piling, used chiefly in cellular structures, works principally under traction by the action of horizontal efforts perpendicular to the jaws.

The effects of bending due to any eccentricity of loading in relation to the webs of this piling should, however, be taken into consideration. When, as in the case of certain sections manufactured in the U.S.A. these webs are arched (Fig. 21) instead of being flat, in such a manner as to form corrugations of 5—6 cm. (2—2½-in.) depth, the effects of bending can be of such importance as to cause permanent and excessive distortion of the wall, which is sometimes dangerous, and is in any case an inadmissible condition.

(See the opinion of Professor Polivca, given during the discussions of Professor Terzaghi's paper, " Stability and Stiffness of Cellular Coffer Dams," Vol. 110 (1945) p.2253 Trans. ASCE.)

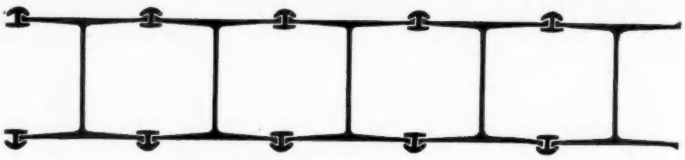
Manufacturers in general guarantee a rupture strength of the jaws of flat piling, at least equal to 300 tons per metre (100 tons per foot) of length, their resistance to rupture having been ascertained on a test bench using two well aligned pile elements. The rupture figure thus obtained should remain unchanged when, in the case of a circular wall, each piling section is offset as towards its immediate neighbour by an angle which may vary from 4° to 12°. This condition is satisfied in the case of jaws of the type shown by Fig 21a as they have but a single point of contact, the finger of the jaw proper serving only for the purpose of guiding during driving. On the other hand, in the case of the jaws shown at Fig. 21b with contacts at two or three points by the finger, and at 21c with contact at two points upon an intermediate jointing piece, the inclination of the piling elements, one to the other, alters the points of contact and brings about an unequal distribution of pressures which increases the maximum stress in the jaws. The eccentricity of the resulting pressures increases also the stresses laid upon the web due to bending, when in normal use.

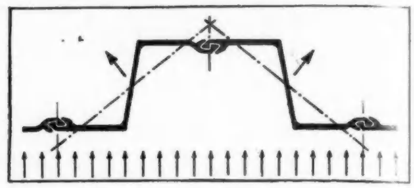


With tractive forces upon the jaws of the order of from 150—200 tons/metre (8,400—11,200 lbs./in.) and using piling with straight webs (not arched), with a thickness of 9 mm. (⅜-in.), it is possible to build cellular or diaphragm structures of heights up to 15 or 20 metres. If necessary, the web thickness may be increased, either for the purpose of reducing stress loading of the steel, or to serve as extra material compensating the destructive effects of corrosion.

* By reason of their very great rigidity, steel box piles do not sometimes benefit to the full extent from the total passive soil pressure (see Chapter 2), unless they are rendered more pliant by being used in a very high wall, which is subjected to heavy pressures.

Modern Applications of Steel Sheet Piling—continued





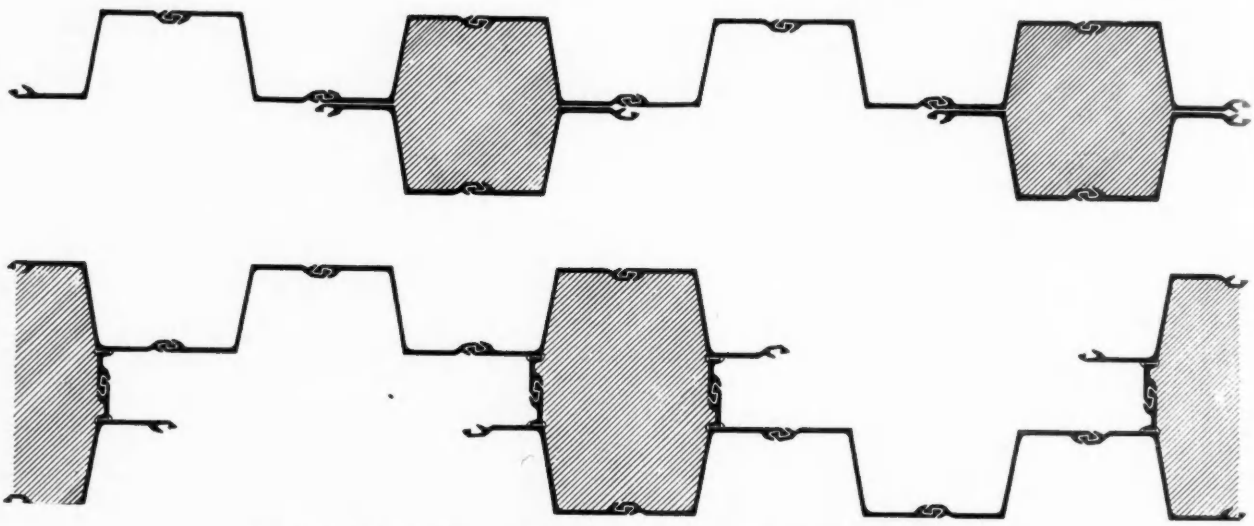


Fig. 19 (top right in box). Deflection of the single elements in a "Z" piling wall.
Fig. 20. Connected box pile wall and reinforced walls of steel sheet piling.

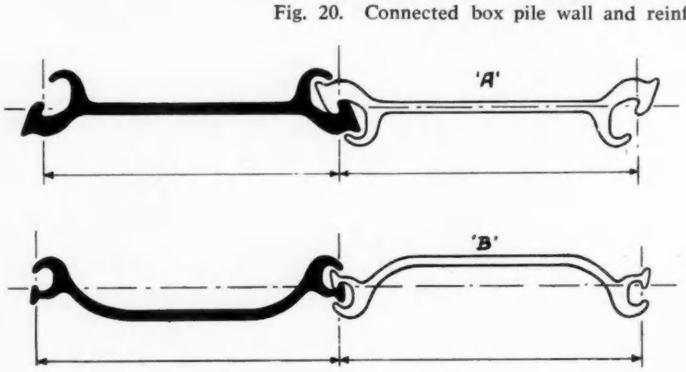
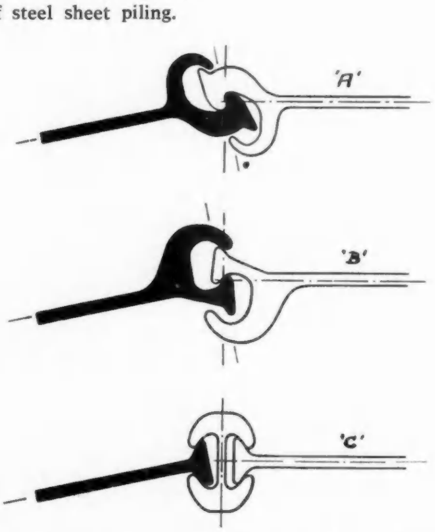


Fig. 21. Sections and Jaws of flat steel sheet piling.



Anchorage and Walings

The method of anchoring a wall of sheet piling is very simple and is carried out by means of longitudinal waling fastened near to the head of each of the elements, the loads being transferred by means of tie rods to the anchorage beam. Accidents which have occurred to sheet piling walls are more often imputable to a defect in the anchorage or waling, the shoring in the case of a cofferdam, and sometimes to an insufficient depth of penetration but rarely to an incorrect choice of section modulus. The question of anchorage and waling, therefore, merits very particular attention.

The section of sheet piling used should be such, as indicated in Fig. 22, that each element will present a perfectly flat area where the walings are attached and likewise the alignment of the wall face should be good and without projections of any kind. As a rule, each piling element is bolted separately to the waling.

The size of the sections used for waling, generally formed of two steel channels, should be calculated generously as the loading upon these may be increased considerably over that calculated, as, for example, when they are used for the purpose of re-aligning a wall after driving or when, by the unforeseen failure of an anchor plate, increased strain is thrown upon them and the traction upon the neighbouring tie rods is increased.

The tie rods are often formed of round steel bars of from 4—7 cm. ($1\frac{1}{2}$—$2\frac{1}{4}$-in.) diameter, spaced at 1.6—4 metres (5—13-ft.) one from the other. They have turn-buckles for the purpose of adjustment and two articulated joints at their extremities, which allow them to follow, more or less, the contour of the compressed soil and any later settlement. On occasion, instead of round bars, cables are used for this purpose, which owing to their flexibility are, to all intents and purposes, unaffected by compression and settlement of the soil. These cables should, however, be well protected against corrosion, and certain defects can arise due to their elongation owing to their relatively low modulus of elasticity and the tendency to creep of certain wires.

Walings and tie rods are also, on occasions, constructed in reinforced concrete.

Modern Applications of Steel Sheet Piling—continued

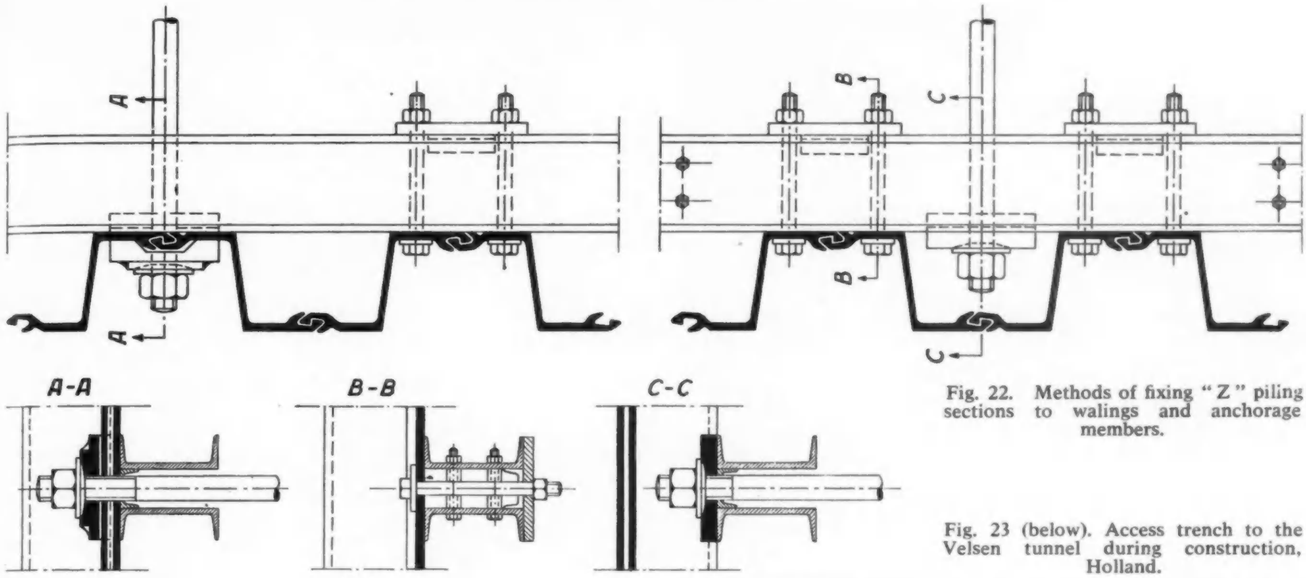


Fig. 22. Methods of fixing "Z" piling sections to walings and anchorage members.

Fig. 23 (below). Access trench to the Velsen tunnel during construction, Holland.

Piling Wall Layouts

Special rolled sections supplied by some manufacturers of steel sheet piling facilitate the connection of walls branching in different directions as shown in the photograph of the piling foundation walls of a large lock (Fig. 5).

Flat sheet piling has been specially conceived for producing circular walls, enclosing a core of earth (Figs. 8-10). The presure of the fill applies horizontal traction to the walls, the connection jaws being specially designed to resist such efforts. Owing to its relatively low rigidity the piling should not be called upon to sustain vertical bending effects of any consequence.

Where it is necessary to construct a circular wall which external forces placed under compression (Fig. 23), flat or arched web piling cannot overcome the large horizontal compressions arising, owing to the large amount of play in the jaws of these types and the danger of buckling the webs or flanges of the sections. In such cases it is, therefore, necessary to use "Z" or "U" section piling which resist such pressures by flexing, as in a straight wall. Anchorage of the piling heads towards the exterior is, of course, impossible, and should be replaced by a strong horizontal internal bracing or an interior circle of beams heavily stressed and of such relative size as is made clear in the photograph (Fig. 23). Such structures are really comparable with ordinary straight walls and should not be confused with those that are, properly speaking, cellular structures.

Execution of Work

It is not necessary to deal with the apparatus used in driving the piling, but it should be pointed out only that successive elements of a wall must be carefully guided in a manner that will permit them to be driven in the correct position, quite vertical, and that any deviation from the vertical should be corrected by interposing special taper piles.

The formation of the circular enclosure for a cellular structure presents some special difficulty in that driving takes place from one point alternately in opposite directions there remaining finally only a space in which the last piling section is to be placed.

It is possible that by reason of slight errors made during placing and driving, the space remaining is not constant in width from top to bottom and that it is in fact slightly wider toward the base. Thus the piling section for completing the cell when connected at either side and driven, would be subjected to increasing stress across its width, as it descended, and be subjected to permanent deformation, or the possibility of tearing longitudinally. Such a rupture of the piling element would be invisible if it were confined only to the buried section of piling. However, if it were of such length as to reach to the top of the soil into which the sections were driven, there would be a possibility of it lengthening suddenly, when horizontal tensions in the wall were increased in the course of filling and causing the element to tear throughout its length.

Such an accident can be avoided if the flat piling elements are connected carefully, and placed in position, using for this purpose a substantial template comprising two horizontal circular stagings, one above the other (Fig. 24) at a distance of say, 2—3 metres (6—10-ft.). The piling sections are then driven to only a very small depth, about 3-ft. being sufficient, and this simply in order to maintain them in position. If, in spite of these pre-

Modern Applications of Steel Sheet Piling—continued

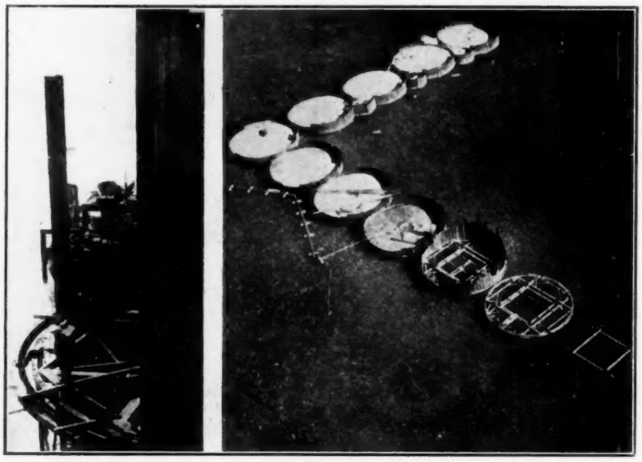


Fig. 24. Cellular constructions of flat steel sheet piling and templates.

cautions, some slight irregularities were apparent the closure element might still be connected at either side and driven without any excessive strain, displacing slightly the neighbouring sections which would be only lightly held in the soil, without any danger of rupture. After the complete erection of the cell has been achieved, the piling should be driven in successive stages to its final depth.

Danger of Corrosion

The danger of corrosion of the steel used for sheet piling, varies considerably from one site to another.

The rear face of a piling wall, which is in permanent contact with the fill is less exposed than other portions as the silica in a sand filling unites itself readily with the surface rust which forms, and thereby becomes a protective coating, adhering firmly and stopping the progress of oxidation.

The outer face of piling when exposed to fresh water is attacked but little. This is not, however, always the case in salt water particularly of those portions which are subjected to tides and more or less covered with seaweed and small shell fish. In the most unfavourable circumstances, steel can undergo a loss of thickness, due to rust, of about 0.1 mm. per year.

Maintenance of sheet piling can be assured, by increasing the thickness of the sections, a measure which has also to be taken where difficult driving conditions are expected. Increase in thickness is rather in the interest of maintenance of the wall of which the part which is most highly stressed is generally that which is below the low water level, whereas the greatest danger of corrosion exists in that part which is above this level.

As a counter to corrosion, additions of 0.25 to 0.35% of copper may be made to the steel, but while results are quite satisfactory in the normal atmosphere or in fresh water, there is some doubt as to their success in salt water. A certain percentage of phosphorus as in Thomas steel appears also to bear good results.

Coating or dipping in tar or bitumen ensures very good protection, above all when this is carried out in the hot state at the rolling mills by modern and carefully controlled methods.

Many other processes in the fight against rust (cathodic protection and others) are being studied and constantly perfected. It can already be said, however, that problems pertaining to the life of sheet piling works can be resolved in a very satisfactory manner by using these means of combating rust which are appropriate to each particular job.

Conclusions

It has been my endeavour to demonstrate that steel sheet piling facilitates the construction, over a very large range, of works for the support or retention of earth and water, responding to the most varied needs of civil engineering. When studying such projects, a choice has invariably to be made between

A heavy and expensive wall, the foundations of which sometimes present particular difficulties.

Reinforced concrete piling which is heavy, difficult to manipulate, always subject to cracking, with joints which are practically always imperfect, and therefore not watertight.

Steel sheet piling, which is relatively light, economical, strong, watertight, easy to transport, erect and withdraw if necessary.

A Remedy for Dock Strikes

Summing up by Poseidon

The criticisms and the comments on the article published in the October issue of this journal reveal not only a lively interest in the problem of dock strikes but, without exception, they are marked by an earnest desire to find a solution for the present trouble.

Corrections

That it is a "very difficult and complex problem" is evident from the misapprehensions that call for correction, before proceeding to the main summing up of the letters received.

Firstly, decasualisation. There can be "no scheme of decasualisation" neither was "casual employment abolished 17 years ago." Seeing that shipping can never be regulated so as to provide work for a constant number of workpeople all the time, employment will always, for the great majority of transport workers, continue to be casual. What has been abolished by the legislation that eventually produced the N.D.L.B. in its present form, is not casual labour but casual payment, i.e. payment for such periods as the worker is employed. That, prior to the second war, was the curse of the industry. The "fall-back" has dealt with that; the register has turned transport work into a "closed shop" to the final discouragement of the casual applicant.

Secondly, "we have in effect one employer in London . . . . the N.D.L.B." The Devlin Report, par. 12, makes it clear, in referring to the Board's predecessor, "the Corporation was not made in law the sole employer." The N.D.L.B. is an agency for the supply of registered labour-units to registered employers; that it is not concerned in industrial matters is fully proved by its quiescent attitude to labour stoppages. Its impeccable impartiality, during these periods of stress, is displayed in the publication each day of the numbers of men not at work.

Employer-labour Relations

Whilst it may seem pedantic to labour these two points it is, in fact, the intervention of the N.D.L.B. in the employer-labour relation that has called forth more comment than any other aspect of the problem. Port employers, whose experience goes back to the first war, are convinced, in spite of the categoric statement in par. 80 of the Devlin Report, that a definite relationship did exist, and that it continued to exist right up to 1939. Those who doubt this and consider the number of "blue-eyes and choice gangs" to have been the exception should bear in mind that, prior to 1940, dock labour was intensely mobile. The "grape vine" warned the unemployed docker often before the shipping company warned the dockmaster. It also warned the employed casual, for there was then no "continuity rule" to anchor him to a job he disliked. Hence the general existence of "followings": in dock circles foremen were often judged by their ability to attract and to hold a good following. Perhaps with the violent disparity in the daily demand for labour as quoted at Manchester, where it jumped from 994 to 3,372, the "relation" could be preserved only by the mobility of these "followings."

The Labour-unit

The impersonal nature of the relation between the Board and the registered worker is well defined by one correspondent who

A Remedy for Dock Strikes—continued

speaks of the docker, directed to a job, as a "labour-unit." If this is a correct description, and there seems little reason to doubt it, then the pool man has as little hope of being happy in his work as a "housing-unit" has of being a warm and cheerful home. This same correspondent makes an earnest plea for the development of a human relation. He hits the nail on the head when he attacks the cold blooded allocation of labour-units to jobs. This is only too often a substitute for the choice of human beings for the job, because of their outstanding qualities. A worker, to do his best, must have his self respect built up. This was a principle accepted many years ago by the early dock companies who bolstered the morale of their workers by a system of differential payments and Contingency Allowances. Anyone who has mistakenly tried, in the sacred name of commonsense and rationalization to do away with these recognitions of inequality (in a society where one man is better than his neighbour), will have quickly realised the tenacity with which these small payments are, quite rightly, maintained.

Discipline among Employers

A point that is well made by one correspondent is the evidence of lack of discipline among employers. The processes by which labour, particularly when at times, there are five jobs for four men, is engaged, employed and retained (in anticipation of the arrival of the next vessel), might with advantage form the subject of an enquiry, under the heading of "the effects on the industry of present methods of competing for dock labour." Within this category might also come the willingness of some employers to accede to extortionate demands made by a few men, generally within a few hours of the vessel sailing, for payments outside the schedule. It may have been belatedly found that the cargo is "dirty," or some other condition is discovered that can be pressed on the employer, concerned in the stress of the moment, with the major problem of getting the vessel to sea. Whilst there is general condemnation of demands of this kind there is no general agreement by employers to refuse them.

Personnel Officers

The suggestion to set up personnel officers, whose function would be to bridge the present gap, is one that deserves further thought. Once again "it would depend on what you mean by a personnel officer." Frankly, the type of officer who would have the support of the employer and the confidence of the workman would be hard to find. He would need to have also the support of the workman and the confidence of the operative and supervisory staff. It would be natural for dock officers to resent "a clerical type" taking an active part in labour arrangements which they regard, with reason, as entirely their province. If he was not made welcome at the dock he would tend to become an indoor type, relying more and more on precedent and regulation.

Reduction in Number of Employers

There is, in the correspondence frank comment on the present employers' register, and a general recognition that "steps ought . . . . to be taken to reduce the absurdly high number of port employers, particularly those small stevedores who contribute nothing to the common good." There must, firstly, be recognition of the very complex nature of dock work and the part played by certain employers in the port as a whole. Put concisely the ideal is "to encourage the regular employment of dock workers by the same foreman under the same management —so that mutual trust and respect can be built up." This is a long way from the present system where "the labour-unit dawdles along to the job, doesn't like the look of it, or of the other men, or of the foreman or ganger." It is in the method of reducing the number of employers that there is, naturally, diversity of opinion. Whilst one correspondent advocates the taking over of small stevedore firms by their larger brethren he does not say how this is to be done, nor the form that the initial urge would take. He is doubtful of the re-action were they to be absorbed by a port authority. In this connection it can be said that minor enterprises which made a specialised living in a port, have before now, been taken over by a port authority to the satisfaction of the staff concerned.

Amalgamation of Employers

A very practical suggestion was made to solve the problem. Where many employers are each burdened with overheads that bear an uneconomic relation to the tonnage they handle, and where gear and staff are necessarily idle and unused for long periods, why not form groups of employers who could rationalise their work and ensure a degree of continuity of employment? It is assumed that the amalgamation would be brought about by the voluntary effort of employers with common interests. Were the experiment to be successful it would go far to reduce the number of supervisory staff—who to the workpeople—represent the employers.

Any reduction, by whatever means it may be brought about, in the present number of employers, is seen as a definite step to closer relations and to a reduction in the casual nature of the employment. Many contend that permanent employment, which could be achieved by the employer paying the fall-back individually, would be worth while, provided that the employer-unit (to coin an objectionable phrase) was large enough to stand the cost. In other words, if the needs of a port were met by half-a-dozen employers of substance, there would not be need for a "scheme," or for the present Board.

The Pool Man's Re-action

Attention is very necessarily drawn, however, to the inherent dislike that many registered port workers have to employment on a permanent basis. Once more the labour-unit insists on behaving like a human being and not as the economic cypher that Whitehall envisages. Some human beings set security of employment as their goal and achieve it by becoming permanent labourers. Others, and these cannot be ignored, prefer "to chase the job," that is to say, to skim the cream off the work. That they are usually highly skilled and reliable workmen permits them to do this. At the same time, as it affords further evidence that some men are much more equal than others, it gives to the few the freedom to work or not as they please, confident that the money is there when they like to go out for it.

Training of Dock Workers

There is agreement that "a training scheme of some sort must come, in order to promote the calibre and status of the labour force." It should consist "not only in the practical side of all types of cargo handling but also in the development of moral standards, physical fitness and general intelligence." The consistent percentage drop in the demands made on the Board for dock workers during 1956 and 1957 is surely an indication of the changed nature of cargo carrying and handling methods. The future, surely, will demand a higher proportion of skilled mechanics. The picture of the docker as the man who pushes a hand truck, day in and day out, or is engaged in the soulless monotony of making up an infinity of bags into a slightly less number of sets, is rapidly becoming obsolete. It is true that a comprehensive training scheme costs money, but if, as is argued by those who have first-hand experience of the Continental experiment, it brings peace to the industry, can we afford to be without it?

An Industry Tied to the Past

A correspondent, who entered the lists late, made the very effective point that is only too well known and appreciated by practical men on both sides of the industry—the "sacred cow" aspect, that so often sterilises the efforts of men of good will to alter practices and to remove causes of irritation and frustration. It is doubtful if any other industry of a like size is so much dominated by the past, or in which it is a tradition that every effort to bridge the gap should be regarded with suspicion. He very rightly remarks "fresh ideas are anathema . . . new policies are suspect," and the Great Strike of 1889 might, from the atti-

A Remedy for Dock Strikes—continued

tude only too commonly encountered, have been settled last week.

Some Operational Suggestions

"The percentage of daily workers over 65 years of age is nearly double those under 25 years." In this bald quotation from the Annual Report for 1957 of the N.D.L.B., is contained the case for a pension scheme for dock workers, now due this month for discussion. What other industry carries the physical and mental incubus of so high a proportion of over-age workers? What other industry would continue through the years carefully to nurture and preserve this biggest obstacle to "full-blooded mechanisation"?

The attack on call-times and the guaranteed four-hour working period is a welcome sign of new thinking. The four-hour guarantee has, since it was so hardly won by Bevin, been considered sacrosanct. It certainly confers a boon on men who are taken on. To those who are not, it implies five hours of waiting around in all weathers in the depressing surroundings of dockland, only too often for an equally abortive chance. What other feeling other than frustration can a man have who wastes day after day in this futile manner? There is something innately repellent in men being subjected to such a soulless and undignified practice. Surely the time is overdue, in the interests of both sides, for a more human and fluid method of engaging labour. When it is obvious—as unfortunately it too often is—that the day will be blank, what justification is there for recalling men at 1 p.m., merely to "bomp-on"?

As though this ill-starred industry had not already more than its fair share of handicaps, the men engaged in it are constantly faced by what must be a unique feature—the alternation of good and bad jobs. The correspondent puts the position pithily, "the scenes when good and bad jobs are on offer at the same time must be seen to be believed." How right he is to draw attention to this and the loss of ship-time that is the natural sequence to the inevitable shorthanded gangs. An increase in the number of permanent men would give employers the opportunity to allocate the less attractive jobs in a manner that could be seen to be fair.

Conclusion

There was mention of the failure by individual dockers to honour agreements; there was consequently reference to the failure of the disciplinary powers vested in the Board, and there was a well argued plea for bringing the unions back within the law. These are all symptoms of the present malaise; any one of them may claim the headlines without warning, and without the public being able to do anything to prevent the consequences being felt by the country as a whole.

The representative opinions that have been expressed on the original article, which was intentionally provocative, and which the writer readily admits "over simplifies this very difficult and complex problem," are a very healthy sign that the problem has at last emerged from the taboo stage.

It has now been openly admitted that the industry is "big enough to find the right answers itself, if only it could get away from the mystifying fear of change." Both sides have been invited to embark on an uncharted sea, where new thinking and fresh ideas should be tested for their value to an industry of the first importance to the nation, but which, for too long, has been anchored to "old casual practices and absurdities."

Mossel Bay Oil Pipeline

The first submarine oil pipeline to be constructed in South Africa was completed last month. The pipeline, which stretches more than a mile from Mossel Bay Harbour to an off-shore terminal, will enable tankers to discharge their oil from the terminal to shore installations, which are now under construction and are due to be completed by April, 1960. The cost of the project is expected to exceed £1 million, and this is being shared by the importing oil companies. The pipeline, about a mile of which will be under water, is 10-in. in diameter and approximately 7,400-ft. long.

Anti-Fouling Experiments in Haifa Harbour

Anti-fouling devices, especially with the aid of poisonous paints, have been sought by ship-repairers and harbour authorities throughout the world, with varying results according to locality as well as treatment. At Haifa Harbour, in Israel, some experiments have recently been conducted jointly by the Israeli Navy, the Port Authority Maintenance Department and the Sea Fisheries Research Station, by submerging rafts of suspended steel plate panels treated with various strengths of cuprous oxide and also non-toxic pigments, in order to find the proportion of the latter which can be included with maximum results.

The tests were conducted by a biologist and chemist and the results show the usual tendency of barnacles and tube worms to be amongst the earliest colonists of the panels and the most resistant to the chemical treatment. Fouling continued throughout the year in these East Mediterranean waters, but was at its highest in summer.

Several foreign anti-fouling preparations failed to have the full effect possible there because of insufficient cuprous oxide (only 6%), compared with those produced with only 35% of their weight and more cuprous oxide. In addition, the concentration of the non-toxic paint ingredient was shown to have an influence on the results, and if used in the proper proportion, to improve, or at least not to impair, the results. The steel plates were first pickled in hydrochloric acid solution, neutralised, rinsed and dried, then coated with zinc chromate, followed by a red iron oxide phenolic varnish, before receiving a single coat of one of 60 formulas for anti-fouling paint. The panels, submerged for periods of up to eight months, were assessed by the area of surface occupied by marine growths. The paints consisted of 7% to 25% cuprous oxide, with a matrix of plasticised rosin and phenolic resin-rosin, together with such non-toxic paints as 16%—50% red-iron oxide, diatomaceous silica and magnesium silica. The different non-toxic paints reacted the same when the proportions of cuprous oxide and inert matrix pigments were the same. Paints with less than 10% cuprous oxide were not effective for more than three months, and above that concentration even at 15%, success for up to 7 months, depended on the amount of non-toxic pigment being not less than 30% of the volume. The minimum amount of non-toxic pigment necessary for adequate anti-fouling protection was shown to be 20%, though this does not require a high concentration of copper.

Fouling in these waters is of a medium nature, although not far to the south the greatest fouling known occurs in the equatorial regions. Slender polychaete tube-worms are often dominant fouling organisms at Haifa (notably *Hydroides norvegica*); but they fall off treated plates more easily than do barnacles. Within a fortnight or a month of the plates being lowered in the harbour bay, the subtropical and tropical barnacle *Balanus amphitrite* began to settle in its larval form. This barnacle is sometimes transported to Britain on ships' hulls, but seldom survives long in the colder northern waters. *Tunicates* or sea-squirts settled from spring till autumn, spreading so rapidly as to cover most other growth. *Bryozoa* and *green algae* were also common growths. There is however an overall variation in fouling due to water temperatures etc. varying from year to year, as well as seasonally, while barnacles and tube worms are perennial growth settling on new panels even in winter. *Tunicates* prefer the warmer season in late spring, favouring more shaded parts on the underside of the hull whereas the polychaete tubes favour the sides of the hull, like the *green algae* and *Ulva* (sea-lettuce or laver).

The tests took place over several years, some fifty yards offshore, where fouling was known to be common.

New Oil Jetty in Persian Gulf

Work will soon be commenced on the construction of a £4 million oil jetty and boat harbour in the Persian Gulf by Richard Costain Ltd., in association with Raymond World Wide Constructors. The project is being carried out by the Iranian Construction Group and is part of a £20 million scheme which they are supervising on behalf of the Iranian Oil Exploration and Producing Co., for a new pipeline and loading terminal to serve the oilfield at Gach Saran.

Port of San Esteban de Pravia, Spain

A Difficult Silting Problem*

By Dr. ENRIQUE VERA GONZALEZ

THE Port of San Esteban is situated at the mouth of the river Nalon, in the province of Asturias, north west Spain. It lies on the tumultuous coastline facing north into the Bay of Biscay. The port figures as the second most important coaling port of Spain, and exports about 1,300,000 tons of coal annually: the rest of the traffic is coastal and the volume of the traffic entering and leaving the port places it tenth in national importance.

The port is well served by road and rail between the mining areas and the quayside and the berthing of vessels is tranquil in all weathers. The variation of the navigable depths within the harbour, due to silting, is however a serious drawback to the progress of development.

The port (Fig. 1) comprises a single tidal dock with a total area of 53 acres, on the left bank (west) of the river Nalon. A stone mole separates the river from the dock except at the gap in the mole which forms the dock mouth at the north end. The nominal water depth at the quayside is 6 metres below L.W.S.T. The dock mouth lies about one mile from the West breakwater head and is 650-ft. wide; at this point the river is about 700-ft. wide at low water. Directly opposite the dock mouth, on the East bank of the river, there is a wide flat beach over 50 acres in extent at low water, which undoubtedly has a tranquilising effect as a wave spender.

The Existing Port

The protection to the existing harbour depends upon a single rubble wall, the West breakwater. It has its root in the rocky headland of Espirito Santo on the west bank of the river Nalon. It is 700 yards long and is of dog's leg form in plan giving an alignment approximately north to south and affording shelter from the north-west gales, yet leaving the harbour open to the north-east gales. The predominant wind is north-west and the heaviest storms from that sector, with waves up to 30-ft. high, usually strike the coast about the harbour at 32° west of North, as indicated by the arrow at the top right of Fig. 1. The fetch is 2,000 miles.

The north-east gales are of lesser intensity with a fetch of about 300 miles, producing a wave height up to 17-ft. and striking the harbour at 12° east of North, as shown by the respective arrow.

On the east bank of the river's mouth there is a stone mole jutting out seawards over the beach of Quebrantos, with its head about spring low water line and 1,000-ft. from the West breakwater head. It follows as an extension of the line of the training wall fronting the township of S. Juan de la Arena. On the opposite west bank and parallel to the above, there is also a training wall fronting the Small Port and part of the old mole. Both walls are partially submerged at high water. The mean tidal range is 15-ft.

The Approach channel from the Bar to the dock is about 1,450 yards long, and varies from 500—600-ft. in width. The bed of the channel, including the bar, that is from Station P114 to Station P106 (see Fig. 1) is of fine sand. Standard water depth is 10-ft. at L.W.S.T.

The watershed area of the river Nalon is 1,500 square miles and contains most of the coalfields of Asturias. From the collieries all the dirty effluents from the coal washing and other industrial plants are passed into the river, or its tributaries. The water is therefore heavily laden with solids, some just a fraction heavier than water.

History

In the sixteenth century there was a considerable maritime traffic on the river Nalon which continued until the nineteenth century, when no less than 1,500 vessels used the port annually. Even at that time the problem of the Bar was serious and claimed many victims during gales. In 1868, attempts to effect a remedy consisted of the regularisation of the river and the construction of the old short breakwater at the Espirito Santo point. It was hoped thereby to scour out the sand of the bar with the ebb flow.

In 1904 the railway from Ujo to San Esteban was opened to transport the coal from inland to the harbour: by 1910 the dock was constructed, comprising division walls, quay walls and training walls. It was during this period that traffic was increasing and conditions were worsening so that the silting of the approach channel became more serious.

In the period 1928 to 1944 the West breakwater was extended and the river training walls were constructed on both sides of the approach channel; but matters did not improve, and for several years dredging failed to maintain the depths, in spite of large increases in the amount dredged. Before 1936 this totalled 600,000 cubic metres annually, after 1939 it was 700,000 cubic metres, and since 1951 it has been over 950,000 cubic metres.

The Silting Problem

There are two causes for the silting of the estuary: (1) the action of the sea, and (2) the transport of the debris and detritus brought down by the river Nalon, including in particular that arising from coal mining and industry.

Apart from the slight dredging that is done at San Juan de la Arena (actually about 30,000 cu. metres annually) for the benefit of the fishermen, all other dredging has been confined to the channel from Station P.124 to Station P.80 and the Dock. It has been found expedient in the study of these zones to split them into sections; that is, the Dock, the Mouth of the dock, the Entrance channel and the Bar; and into sub-sections (each approximately 277-ft. apart) which have station numbers prefixed P (see Figs. 1 and 2).

The volume of the dredging for the dock presents little difficulty: it amounts to 200,000 cu. metres annually.

The silting of the approach channel is more difficult, for it not only differs very widely from section to section but varies considerably with the seasons; in summer it is sometimes near the zero mark. The volumes dredged in the last few years average as follows:—

P.80 to P.88	... ...	150,000 cubic metres
P.88 to P.106	... ...	250,000 cubic metres
P.106 to P.114	... ...	100,000 cubic metres
P.114 to P.124	... ...	250,000 cubic metres

The silting up of the estuary is undoubtedly due to the two causes already mentioned and observation shows that the debris from the river is washed down to the estuary and is there halted by the sea.

It is evident that all the silting between Stations P.106 and P.124 has been caused by sea action, the reasons for this being:—

(1) The prolongation of the line of H.W.S.T. of the Quebrantos beach is precisely in Station P.106, and it is logical to accept that the action of the waves reaches equally to both sides of the East breakwater.

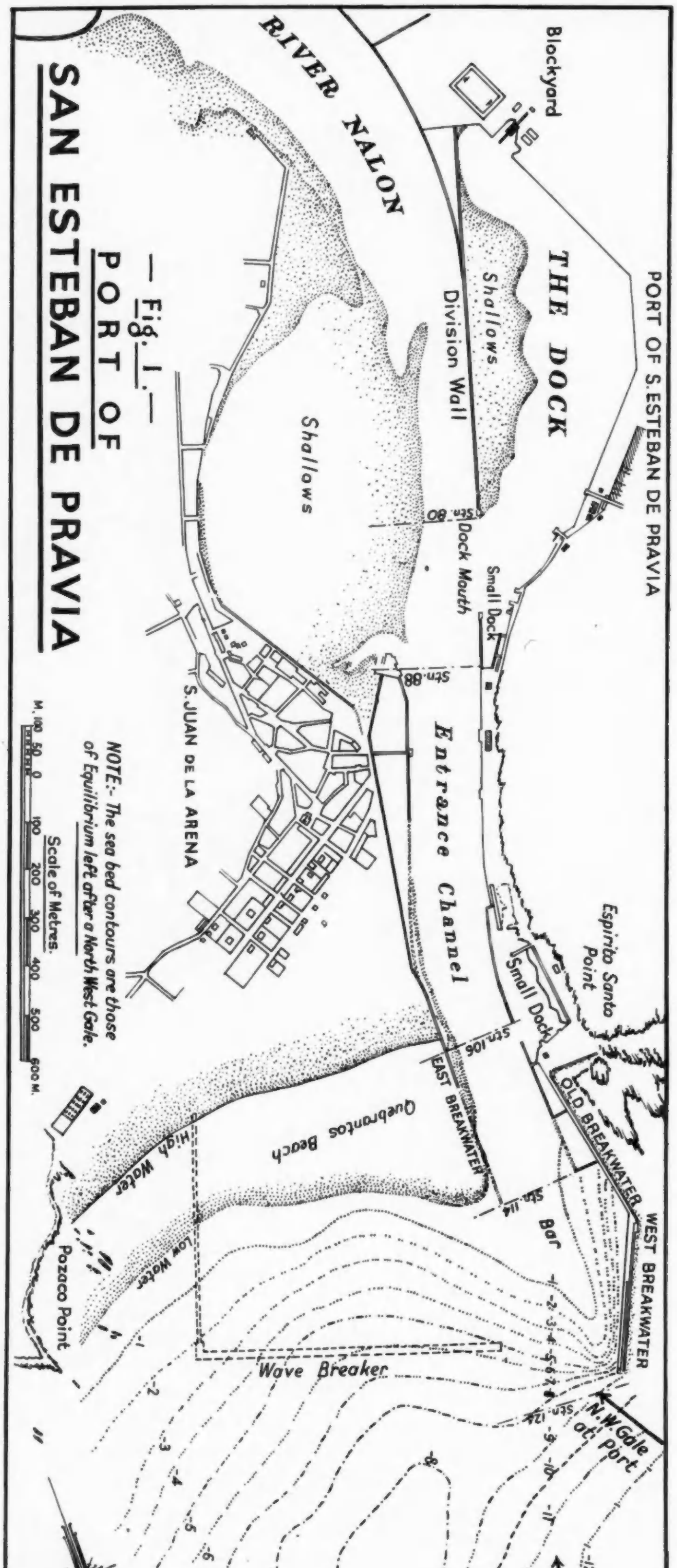
(2) During storms, waves reach this point, P.106 with their full effect.

(3) The up-river section (P.104—P.106) has required the least dredging and is therefore the section of minimum silting. This could well be the limiting point of action of both causes, marine and fluvial (see Fig. 2).

It is much more difficult, though not without interest, to separate the respective volumes of dredging for the Mouth of the dock and the Entrance channel, seeing that the former is in immediate proximity to the latter, and the sediments have the same fluvial origin and a similar mechanism of sedimentation.

*Translation from "Revista de Obras Publicas." April 1958.

Port of San Esteban—continued



— Fig. 1. —
PORT OF
SAN ESTEBAN DE PRAVIA

To distinguish the Mouth of the dock the following criterion was used—when the flow of the river is normal or even in light flood, there occurs, as the rising tide swells into the estuary, a line of separation that marks the highest limit of the advance of the sea. This line advances up-stream and with the river normal (a little before H.W. at the place indicated approximately at Station P.88 on Fig. 4) or with the river slightly swollen, the line establishes itself a little downstream of Station P.88.

Hence this situation can be considered as indicating the limit between the Mouth of the dock and the Entrance channel. In such a case, and also when there are no full floods, the entrance channel is filled at high water with the clear water of the sea and the Mouth is entirely full of the muddy waters of the river. At peak high water the velocities fall to zero, thus it can be appreciated that the Mouth is in a worse state than the Entrance channel.

The dredging diagram (Fig. 2) shows that at P.88 there is an abrupt diminution of the intensity of silting, which confirms that this section divides the zones which must be considered separately.

It would appear that a definite proportion, say 20 per cent. of the deposits produced in sections P.88 to P.106 (Entrance channel) are of marine origin: the explanation is that, especially when the Bar is high, the rising tide and wave action push the solids of the Bar further up-stream.

The silting of the dock takes place slowly, whereas the silting of the Bar, Entrance channel and dock Mouth, in general, occurs suddenly; at times the water depth diminishes 6-ft. in three or four days, as a result of storm or flood. The small boat dock at the north corner of the main dock sometimes, in a few hours, loses water depth very rapidly, due to the formation of eddies set up at the entrance-head of the division wall.

Thus it is apparent that almost all the silting of the Bar and a portion of the Entrance channel, totalling about 400,000 cubic metres annually, is due to sea action, and the remainder of the total dredging, somewhat more than 550,000 cubic metres, is due to river action.

Marine Silting

The Bar which always forms in the Nalon estuary, due mainly to the normal, or almost normal, action of the waves, worsened after the extension of the West breakwater. The storms driving towards the harbour from the north-west quarter, with waves up to 30-ft. from trough to crest, transported sand from the agitated zone to the sheltered zone, and left the estuary in the serious state indicated by the sea-bed contours of Fig. 1.

Gales from the north-east are not so heavy, but they also contribute in pushing the sand further up the river.

Comparing the sea-bed contours on Figs. 1 and 3, the general effect of the breakwater extension can be clearly seen. Also, outside a line drawn from the head of the West breakwater to Pozaco point, that is to say approximately outside the shelter afforded by the wall from the north-west gales, the sea-bed, except in one small zone which has gained one metre, is more or less as it was before the construction of the breakwater extension. It is worth noting that, of the many millions of tons of transported material brought down by the river or dumped from dredgings, the major part has been dispersed away from the coast foreshore. It has been argued that this is generally the case where the transported material is not excessive and the sea action is strong. On the other hand, where the sea action is weak, the sediment accumulates in the estuary and eventually forms a delta.

At the time the West extension was being constructed work was proceeding on the East breakwater, and later this gave rise to the mistaken conclusion that the East breakwater was responsible for the worsening of the Bar. There is no doubt that it has a small effect but it is limited in dimension and intensity. It is caused by the East wall confining the river to a narrower channel but avoids the formation of conditions such as exist alongside the West wall.

The Bar is actually formed between Stations P.110 and P.114 at the stable depth of 3-ft. L.W.S.T., but often falls one or two feet below this figure.

Port of San Esteban—*continued*

The Transport of Sand

As already noted, the probable transport of sand from the agitated zone to the sheltered zone can be clearly deduced from the given data of the sea-bed and weather conditions. Fig. 1 shows a typical problem, the solution of which is due to the well-known Engineer, D. Ramon Irbarren.

Notwithstanding, it is contended that the cause of the transport is not a transversal current originated by the difference of super-elevation, and it does not appear reasonable to assume that a current could exist which at all points directs itself towards the sheltered zone, since it lacks the conditions of continuity and balance (the volume entering must be equal to the volume which comes out). Above all, it can be demonstrated that the difference of super-elevation is not the cause of an instability that originates a current towards the sheltered zone, except that it is the necessary condition by which there is a dynamic transverse stability.

This can be demonstrated approximately as follows:—

The equation of transversal stability is :-

$$\frac{1}{\rho}\frac{\partial P}{\partial y_0} = -\frac{d^2x}{dt^2}\frac{\partial x}{\partial y_0} - \frac{d^2y}{dt^2}\frac{\partial y}{\partial y_0} + \left(g = \frac{d^2z}{dt^2}\right)\frac{\partial z}{\partial y_0}$$

where

$$x = x_0 + r\sin\varphi;$$

$$y = y_0 + \frac{L}{\pi}\frac{dh}{dy_0}\frac{r}{h}\cos\varphi;$$

$$z = z_0 - r'\cos\varphi - \frac{\pi h^2 K}{2L}$$

Plane XY must be horizontal

$$\frac{P}{\rho g} = z_0 - \frac{\pi h^2 K}{2L} + \frac{\pi r^2}{2KL} + \left(\frac{r}{K} - r'\right)\cos\varphi;$$

$$T = \sqrt{\frac{\pi L K}{g}}$$

Substituting, assuming that h is a lineal function of y and neglecting terms of third power, it becomes

$$g\left[-\frac{dh}{dy_0}\frac{\pi h K}{L} + \frac{dh}{dy_0}\frac{\pi r^2}{KLh} + \frac{dh}{dy_0}\left(\frac{r}{hK} - \frac{r'}{h}\right)\cos\varphi\right] =$$

$$= \frac{dh}{dy_0}\frac{\pi^2}{T^2}\frac{r^2}{h^2}\sin^2\varphi + \frac{\pi^2}{T^2}\frac{L}{\pi}\frac{dh}{dy_0}\frac{r}{h}\cos\varphi +$$

$$+ \frac{dh}{dy_0}\frac{\pi^2}{T^2}\frac{r'^2}{h}\cos^2\varphi - g\frac{dh}{dy_0}\frac{r'}{h} - \cos\varphi - g\frac{\pi h K}{L}\frac{dh}{dy_0}.$$

simplifying:

$$\frac{\pi g}{LKh}\frac{dh}{dy_0}(r^2 - r'^2)\cos\varphi = 0$$

This means that the above equation suffices practically, seeing that we always assume this term as negligible. On the other hand if there were no difference of super-elevation the term is not balanced and there is no transversal stability. Admittedly this demonstration is not absolutely exact but nevertheless it serves the present purpose.

The reason for all this is to show that, in the transversal oscillating movement, the forces of inertia are not truly harmonic but that they have besides a constant component which stabilises the difference of super-elevation.

Where the River Nalon is concerned, it is believed that the cause of the transport of sand can be best explained as follows:—

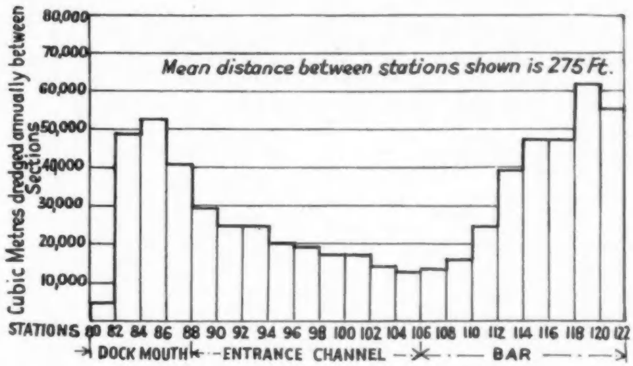


Fig. 2. Profile of dredged sections in volume per year in cubic metres.

Whether the wave is one of rotation or not, but more particularly when it is, the sand of the sea-bed is loosened or picked up, in a much greater proportion when the wave crest passes over it ($\varphi = O$) as at that time the velocities at the bed are maximum; the larger part of the sand picked up is in suspension then ($\varphi = O$) until a moment when one can estimate intermediate between $\varphi = \pi/4$ and $\varphi = \pi/2$

Clearly it is seen in the formula of oscillating transversal movement that during this time the transversal velocity

$$v_y = L/T\,\frac{dh}{dy_c}\,\frac{r}{h}\,\sin\varphi$$

is negative, that is to say directed towards the sheltered zone, and in this direction it carries the sand in suspension and deposits it there. In the following semi-period, the velocity of the transversal oscillatory movement is directed towards the agitated zone but then the transport of the sand is least, because the height of the wave is less, particularly because it takes place after passing the crest when there is least sand in suspension.

Thus the sand is deposited in the quiet zone and is built up in banks so lessening the water depths. The definite theoretical equilibrium takes place when the transversal slope of the sea-bed reaches that which balances the transport of sand in the two senses; actually stability occurs somewhat earlier.

The River Siltings

The sediments that form in the dock Mouth, Dock and Entrance channel are due almost entirely to the deposits of the river Nalon which, as already stated, is laden with debris and silt not only from its own course but also from the mines and works upstream. The dock acts as a gigantic settling tank, which, owing to the mechanism of the tides, receives in a day a million

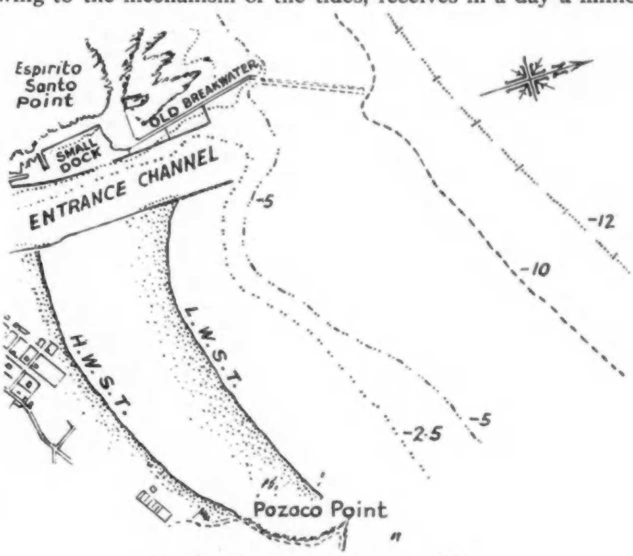


Fig. 3. The port as it was in 1923.

Port of San Esteban—continued

cubic metres of turbid waters, especially during floods, when the velocity is annulled at the peak of high water.

As the proportion of solid material held by the water is never less than 2 per thousand and sometimes reaches 7 or more per thousand it is easily understood that the deposits reach formidable figures: actually it is necessary to dredge over 200,000 cubic metres annually to maintain the dock in a minimum condition to deal with the traffic.

The silting of the dock Mouth and of the Entrance channel has an origin similar to the dock, yet the mechanism which produces it is a little different. To distinguish the cases:—

(a) River more or less normal, and including slight floods.
(b) Heavy floods.

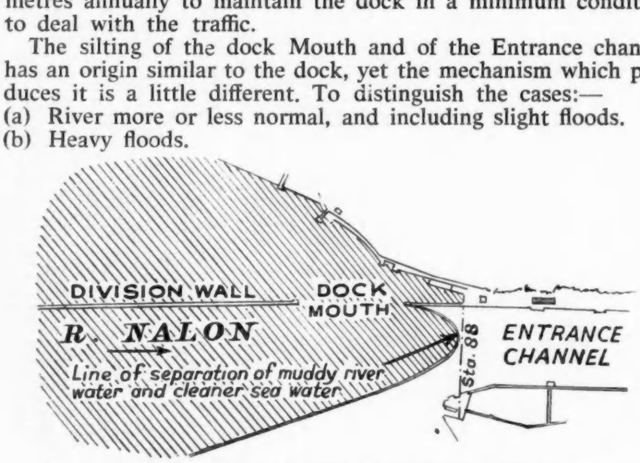


Fig. 4. State of water separation of river and sea water at high water springs at the mouth of the dock.

The river floods take place in both cases but with more intensity in (b).

Case (a) deals with a typical case of sedimentation in an estuary, and as such is affected by the tides. This has been studied widely by various authorities and lately it has been the subject of an exhaustive research by the American engineers Schultz and Simmons. In a rising tide the ascending flow, in normal circumstances, counterbalances the descending velocity of the river; both of them are influenced by the currents of density which cause the lighter fresh water of the river to over-ride the heavier salt water ascending the estuary on the sea-bed. This produces a plane of separation between the descending water of the river and the ascending water of the sea.

In the particular case of the river Nalon, and when there is no flood, a line of separation is well defined. The rising tide mounts the estuary as far as the dock Mouth, where it persists until a short while before high water in the form indicated in Fig. 4. Near this line of separation the velocity is zero and, as a result, the solid particles carried by the river and, in lesser proportion, the transported material of the sea water picked up from the Bar, are deposited in the area.

As the line of separation remains still for some time in the dock Mouth (it cannot travel further upstream because of the existence of the dock and a weak tidal current in relation to the flow of the river) it is in this zone that heavy deposits take place.

In case (b), that is to say when the discharge surpasses 150 cubic metres per second in large floods, the mechanism of sedimentation is a little different, as in no part of the river is the velocity annulled. The flow is always to the sea and there is no line of separation. On the other hand, the detritus is of greater quantity, and is deposited when the velocity diminishes; this effect reaches its maximum in the ultimate moments of the flood, and heavy deposits are left in the Entrance channel and the dock Mouth. Nevertheless, during the last stages of a flood a line of separation may sometimes occur, and then the circumstances become similar to case (a), resulting in a yet greater deposit in the dock Mouth.

To sum up, with normal river flow or small floods, the deposits are not very great and take place almost exclusively in the dock Mouth. In heavy floods, the silting is very great in the Entrance channel and even more in the dock Mouth. Whatever the conditions, the mean annual intensity in the dock mouth is more than double that in the Entrance channel, as shown in Fig. 2.

Over seventy years ago the depth of the Entrance channel remained stable at 10 to 12-ft. at L.W.S.T., now it is 2 to 3-ft., and in some zones zero.

Proposed Solutions for the Silting Problem

Since 1868, when D. Petro de la Sala produced the first proposal for the improvement of the navigation channels of the Nalon estuary, and until 1935, the many solutions advocated revolved about the idea that a well designed project of river training to increase its scouring power would be effective to maintain the depths on the Bar. This is surprising seeing that, at that time, the coal industry upstream had neither the importance or the plant they have now. The optimism of the promoters of the scheme was doubtless due to the little real knowledge they had of the phenomena of the movement of sea shore sands. The reality was not so attractive, since those works which were tried had not the slightest effect upon the Bar.

In 1935, the urgency of the problem of fluvial siltings gave rise to the initiation of investigations and plans for a scheme to separate the course of the river Nalon from the Entrance channel to the Dock. The scheme that found favour was an arrangement of contiguous channels.

This period of new ideas and of conflicting views between training and separation channels lasted until 1952, when Dr. Gonzalez Valle, the then Engineer Director of the Port, following the suggestions of Professor D. Ramon Iribarren, tackled the problem in possibly the only way it can be resolved. This is essentially distinct from all the suggested solutions and consists in treating the matter as two distinct problems, maritime and fluvial.

Firstly, the maritime would be dealt with by means of a counter breakwater, or wavebreaker, to function as described below. Although the maritime siltings do not exceed 35—40 per cent. of the total volume of the port, they present a great danger to navigation in the place where they are deposited owing

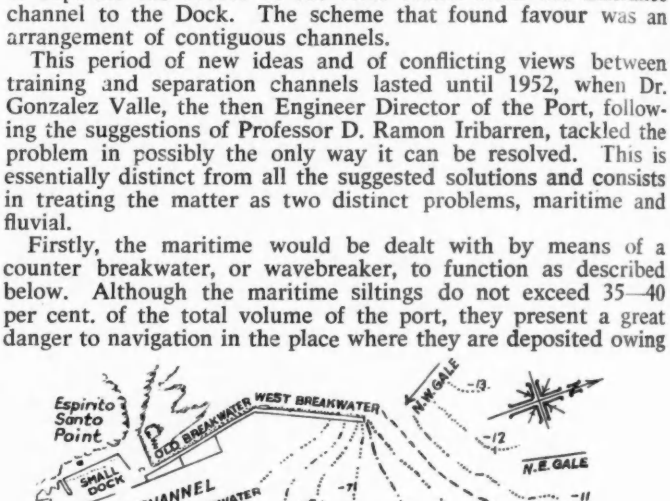


Fig. 5. Distribution of depth contours.

to the rapidity of bank formation and the difficulty of dredging. They constitute a problem the solution of which must have priority over the river as it would be dangerous and practically impossible to make a change in the course of the river whilst the problem of the Bar remains unsolved: only then can the river be dealt with effectively.

From the records, it was previously considered that training walls and groynes would bring improvements to the depths of the Entrance channel and the Bar, but the fears of restriction of flood water discharge made the proposals unacceptable.

The Counter Breakwater

The object of the Counter breakwater, or wavebreaker, already discussed is to avoid, or at least diminish, the formation of the Bar between Stations P.106 and P.124 (Fig. 1).

The fundamental idea, evolved by Professor Don Ramon Iribarren is as follows: With the dominant north-west gales and owing to the shelter given by the West breakwater, there exists a strong transport of sand from East to West, that is from the agitated to the quiet zone. With the counter-wall placed in the selected position there is established a quiet zone in its shelter, thus promoting a transport of sand from West to East; this

Port of San Esteban—continued

means in effect, from the front of the actual estuary, towards the counter-wall. The least quiet part is precisely in front of the Entrance channel and therefore there will be the greatest depths in this zone.

Comparing Fig. 1 and Fig. 5 (in which are indicated the probable distribution of the depth contours after the construction of the counterwall or wavebreaker) it will be at once clear what is meant. As can be seen, the wavebreaker does not act simply as a screen which impedes the passage of the sands from outside.

Mathematical investigation demonstrates that the complex laws of equilibrium which relate the heights of waves, velocities, depths, debris transport, etc., with a change of the limits of the conditions, establish a new distribution of all variables, and in particular of the depths, which are of most interest in this case.

The gales from the north-west are less violent and do not alter the situation, seeing that in this case also, the wavebreaker gives shelter and halts the sand. Undoubtedly some sand will enter between the breakwater heads, but the amounts will be small and will be deposited in the rear of the counterwall and therefore will not form a bar in front of the estuary.

The typical section of the wavebreaker or counterwall is shown in Fig. 6. For the present, the top is 10-ft. above L.W.S.T., which is about mean sea level. It is possible in the near future, after the wall has shown its capacity for the task, to increase its height to reinforce its effect and avoid the overtopping of sand laden water.

The proposed section has a core of 80-ton concrete blocks; the weight being computed from the Iribarren formula for waves of 30-ft. in height in the proximity of the wall, and increasing to 32.5-ft. in height on breaking, and allowing for the increase produced by the wall.

The estimated cost of the wavebreaker is approximately £400,000.

The Diversion of the River Nalon

To avoid the silting due to the river Nalon, the only positive solution is the diversion of its course to by-pass the Dock and the approach channel. It has been decided therefore to divert the outlet to the sea by the construction of a new course, running to the east of the small town of San Juan de la Arena, and debouching at the eastern side of the Quebrantos beach. The great advantage of this location is that it leaves the western side of the town free for future development as a commercial and fishing port.

The decision to give priority to the construction of the counterwall is considered opportune and prudent, although it is appreciated that with a complete diversion of the river a valuable scouring element will be lost. Even if the flow were suppressed too much, in the region of a stretch of the river course of some 10 to 12 kilometres of tidal waters, it would only be possible to use the energy of the dock water to scour on the ebb, with a resulting disadvantage at the Bar.

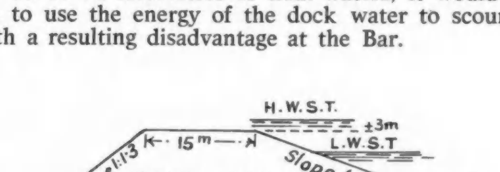


Fig. 6. Wavebreaker cross-section.

According to the formula developed by O'Brien and Le Conte they take the section of entrance at mean tide in function of the volume of water stored upstream by the tide. In simple terms, if the flow on the ebb tide (emptying) is, for example, 100 cubic metres per second plus 50 cubic metres per second for the river, giving a total of 150 cubic metres per second of tide water and river discharge, the river once diverted will probably be 25 cubic metres per second or only 1/6th of the above. Such a reduction could worsen the condition of the Bar considerably. There have been various similar cases.

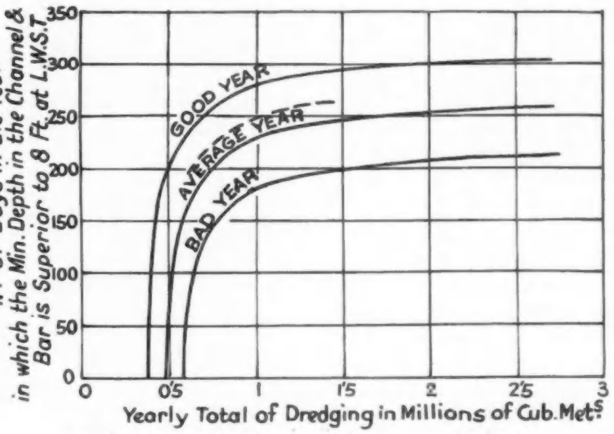


Fig. 7. Graph showing annual volumes dredged.

Dredging

It is a constant struggle to maintain the port in a satisfactory condition without intensive dredging, and even then, the work of two or three months is annulled in as many days. For example, in June, 1953, when the estuary was in very good condition and it was felt that there would be little fear of abnormal siltings until the following autumn or winter, there occurred a heavy inundation which choked the Entrance channel to 2 or 3-ft. at L.W.S.T.

The port of San Esteban de Pravia possesses several dredgers, both suction and bucket, which are used exclusively for the maintenance of the Entrance channel, although sometimes they are used at other ports when the necessity arises. In late years the volumes dredged annually have been:—

1951	...	956,000	1954	...	710,000
1952	...	1,172,000	1955	...	676,000
1953	...	1,076,000	1956	...	1,135,000

The opinion that it is necessary to dredge, in all ports, at the same intensity to obtain immediate benefit or merely to ensure the fixed depth as defined by port custom or regulations, does not seem acceptable. In the first place it is practically impossible to achieve and maintain. Secondly, there is no essential reason why the fixed depth should be, say, 10-ft. at L.W.S.T. and not some other, say 8 or 12-ft.; probably it would be more convenient to maintain 10-ft. in summer and some lesser figure in winter. Thirdly, it should be taken into account that, the more dredging is done the more sediment is deposited. To increase the depth and area of section in the Approach channel may reduce the velocities and will probably augment the deposit of sand. The depth that a gale or flood leaves in the Bar or channel does not depend upon what it was before. Frequent dredging makes cavities or troughs which then receive fresh debris and sediments: this is particularly true in winter when there is a greater probability that the work of weeks may be demolished in a day or two.

Many years' experience of port dredging seems to show that what may be termed the "quality of a port" serves as a helpful guide for future programmes. This takes the form of a graph showing the annual volumes dredged, plotted against the number of days in the year in which the determined minimum depth of water was registered. For example, see Fig. 7, which shows the days of the year in which the depth is equal to, or greater than, 8-ft. at L.W.S.T., as an index to the state of the port.

Without pretending an impossible exactitude, the form of the curve is usually of the same type from one year to another, as indicated by the markings "good," "average" and "bad" in Fig. 7.

In many ports there is a minimum quantity to dredge annually, and without this it could be said, the port could not thrive. If, however, this volume is, say, 500,000 cubic metres per annum, above this total the dredging is each time less profitable and there comes a time when the intensification of it shows little gain.

Port of San Esteban—continued

If dredging one million cubic metres annually results in 250 days of the determined depth, then to extend the period to 260 days at the same depth would mean dredging 1,300,000 cubic metres: this is indicated by the dash line XX superimposed on the graphs Fig. 7. The point is, that the extra dredging of 300,000 cubic metres at a cost of about £40,000 has only gained 10 days' extension of the normal period, and even then, due to the vagaries of the weather and the impossibility of lengthy forecasting, the greater part of this sum could be considered a dead loss; as is the case with some other activities dominated by the law of decreasing returns.

The critical point, which should be marked on the graph, is where the cost of the dredging must be equated with the probable revenue return to the port. This is a situation in which mathematics cannot help and only long experience will suffice. It will be appreciated that dredging should only be undertaken at the times and in the form convenient: it should be intensified only when the necessity is precise and revenue producing; and repairs to the dredgers should be arranged at the opportune time in order to obtain the maximum return from material, personnel and outlay.

In view of the foregoing one questions, in this particular case, the necessity for the total dredging of the Dock, of which only half is utilised near to the quay walls and this at a cost of dredging 200,000 cubic metres per annum, to maintain with difficulty a depth of 20-ft. L.W.S.T. The rest of the dock area is occupied by the low ground near the division wall, which is dry at half tide, and to maintain the full dock area at 20-ft. would mean increasing the dredging by 100,000 to 150,000 cubic metres annually. There is not the necessity at present, however, for vessels have no difficulty in using the port.

Conclusion

It is not easy to put into figures the different economic factors that come into the question, since its natural complexity is aggravated by diverse circumstances. One does not know exactly the detailed cost of dredging since the State (Public Works) does not supply analyses of costs, and does not take into account interest and amortisation costs, etc.

As a matter of interest, however, it is possible to give some idea of the estimated cost of the works. For the wavebreaker wall and the diversion of the river, including provision for the later heightening of the wall crest, the cost is approximately £1,500,000, and the probable cost of dredging is £166,000 per annum, provided there is no change in the dumping grounds and methods. The present costs of the port dredging is cheaper than for most ports. In any case, should the new works prove satisfactory, there will be a considerable economy and a great improvement to the security of the port. For several centuries efforts to improve and stabilise the depth of the port have been unsuccessful, and it seemed that no further durable improvement was possible. However these new works, thanks to the theories and expert advice of Professor Don Ramon Iribarren and the competency of the Engineer-Director Don Jose M. Gonzalez del Valle, give hopes of a sound and lasting solution.

R.R.M.

Modernisation of Port Radar Station at Liverpool

In July 1948 the first major Harbour Surveillance Radar system in the world was opened at Gladstone Dock in the Port of Liverpool and, in the last ten years, has proved so successful that other port authorities throughout the world have followed the example of the Mersey Docks & Harbour Board and have set up similar equipment in their ports. The original station at Liverpool was closed down last December and the equipment will eventually be handed over to the British Science Museum. It has been replaced by a new station equipped with the Decca Radar Type 32, which has been specifically designed for use at ports having high traffic densities. The principal differences, from an operational point of view, between this equipment and the old are a much higher degree of resolution in both range and bearing, the provision of seven displays instead of six and the increase in scale from 2-in. to the mile to 4-in. to the mile for the narrow Crosby Channel. Similar equipment has been fitted at Southampton and is being supplied to the Port of London Authority and to Hamburg.

The Chairman of the Mersey Docks and Harbour Board, Mr. M. Arnet Robinson, opened the new station on the 2nd of this month.

The object of the original installation was to assist vessels to navigate the river and approach channels in periods of bad visibility and also to provide an efficient ship-to-shore communication service which is particularly essential in congested waters. In fine weather the principal assistance provided has been the issue, by radio telephone every four hours, of situation reports to pilots describing the position and movement of every ship at anchor or under way in the river or its approaches. Navigational warnings and weather reports are also included. In bad visibility when pilots ask to be kept under observation minute by minute information of the exact position of the ship is passed by radio to assist the pilot and supplement his own intimate local knowledge. In this way safe navigation can be maintained where the visibility might otherwise preclude further progress.

Since 1948, 5,332 vessels of almost 28 million gross tons have received radar assistance and the service has proved to be a valuable asset both as a time saver and as an aid to safe navigation. Although the results obtained from the original installation have been very

View of the Radar Room showing the seven P.P.I. Displays.

satisfactory there have been, during the past few years, many technological advances in this field and the Board therefore decided that modern equipment be installed in a building specially constructed for the purpose. The total cost of this re-equipment is about £72,000.

Technical Information

A new building has been built at Gladstone Dock to house the electronic gear which consists of 3 cms. radar equipment of exceptionally short pulse length and V.H.F. F.M. radio equipment. The 25-ft. high-gain narrow beam radar reflector is sited on the original radar tower. For reliability and to ensure continuous operation during routine maintenance, there are two entirely separate radar channels with remote control changeover facilities. The particular operational requirements at Liverpool dictate the use of seven advanced fixed coil displays, all fed from the one radar source, and deployed as follows:—

Display No. 1

Off-centered to show a small scale long range general warning picture out to a range of 20 nautical miles from the radar site, at a scale of approximately 1 nautical mile to the inch.

Liverpool Radar—continued

Exterior view of the new port radar station.

Displays Nos. 2, 5 and 6

Off-centered to show in large scale the harbour and its approaches and covering an area of 5 nautical miles diameter at a scale of approximately ½ of a nautical mile to the inch.

Displays Nos. 3 and 4

Off-centered to cover the Crosby Channel and showing an area of 2½ nautical miles diameter at a scale of approximately ¼ nautical mile to the inch.

Display No. 7

Available as an operational safeguard. It can be switched to cover the operational function of any of the other six displays.

Apart from the choice of the above range scales and off-centering facilities, each display will incorporate one interscan line. Variable by simple controls in range, bearing and origin, this type of continuously painting electronic line is the most accurate method of obtaining measurements between any two points on the face of a radar display. Another facility is the use of Deccaplot reflection plotters on which will be engraved channel limits and buoy numbers.

Improved Ship-to-Shore Communications

Following the installation of the Liverpool Port Radar in 1948, a new R/T communication system using six channels AM/VHF was installed with the advice of the General Post Office, the system of modulation and frequency employed being those which the G.P.O. anticipated would be internationally adopted for port operation services. In this scheme there are nine shore stations and 150 portable sets carried by Pilots and, in addition, some 70 ships which visit the port frequently, including some of the large tankers, are fitted with 10 watt fixed sets in the ships themselves. In the 12 months ended August 1958, 7,490 ships received their docking orders and other operational traffic through the two channels operated from Port Radar Station and a greater number passed traffic through the various subsidiary stations at the dock entrances in connection with their immediate berthing orders. Unfortunately, amplitude modulation was not accepted internationally and no agreement was reached until the Hague Conference in January 1957, the conclusions of this Conference being ratified in October of that year.

The Port of Liverpool is keeping its present system in operation for a further two or three years, but is installing channels 12 and 16 of the Hague Agreement in order to provide the service for ships fitted with the new type of equipment during this period.

The Dock and Harbour Authorities' Association

Abstracts from Annual Report for 1958

The Report of the Dock and Harbour Authorities' Association for 1958 was presented at the annual meeting in London on the 12th of this month and at its commencement, regret is expressed that the Finance Act, 1958, which substituted a flat rate of Profits Tax for the two-tier rate, did not take account of what the Association believe to be the special position of port authorities, bound by statute as they are as a general rule, to apply any surplus income in improving the port or in decreasing port charges. They do not make a profit in the usually accepted meaning of that word.

The introduction of the flat rate of Profits Tax has resulted in a material increase in the amount of this Tax which certain independent port authorities have to pay. "This seems an unfair burden when it is remembered that such ports are trading in competition with the nationalised ports which, although liable, are not likely to pay the Tax in the foreseeable future because such profits as they have made or will make are offset and will continue to be offset by losses on other undertakings of the British Transport Commission."

The Association are also greatly concerned at the expenditure which certain members are finding it necessary to incur on works of modernisation, improvement and enlargement to cater for the increased size of ships now being built; the special position of shipping was recognised by the Finance Act, 1957, and the Association believe that, as a necessary complement, the Investment Allowance should be restored in respect of expenditure on works of port development and modernisation at a rate equal to that for ships.

The report states that the Association have raised these matters with the Treasury and they hope that the special position of ports will be recognised in next year's Budget.

Shipowners' Liability Act

The report summarises the Merchant Shipping (Liability of Shipowners and Others) Act, 1958, and comments that while the liability of members for loss or damage caused without their actual fault or privity to any vessels or goods, merchandise or other things on board has been increased some three times, the new amount of approximately £23 13s. per ton does no more than keep pace with the depreciation in the value of money that has occurred since the former amount of £8 per ton was originally fixed in 1862 in relation to a shipowner's liability.

The main concern of the Association in connection with the Bill related to the possibility of an alteration in the law relating to wreck removal expenses. The report recalls that the Association had agreed with the Government to consider from what source port authorities should be reimbursed the amount of any loss which they might sustain in consequence of limitation being permitted for wreck removal expenses. After consideration, it was suggested to the Ministry of Transport and Civil Aviation and to the Chamber of Shipping and the Liverpool Steam Ship Owners' Association that use should be made of the General Lighthouse Fund for this purpose; the Ministry thought, however, that this would not be appropriate and rejected the proposal.

The Association thereafter decided that the only other acceptable scheme would be the setting up of a Joint Committee with power to manage a wreck fund maintained by dues levied on vessels and with a right to insure the liability of the fund. A draft scheme was prepared which would have given the proposed Committee wide powers but when the scheme was sent to the Chamber of Shipping and the Liverpool Steam Ship Owners' Association for their comments they expressed the view

The Dock and Harbour Authorities' Association—continued

that, because of the increase in the limitation amounts, there was no necessity for any scheme.

The Association did not accept this view and, as it was not possible to reach agreement, a provision was included in the Bill for the Act, under which the provisions enabling a shipowner to limit his liability for wreck removal expenses would not be brought into force until such date as the Minister may by order appoint.

The Minister is also given power by the Act to make provision by order for the setting up and maintenance of a fund out of which port authorities would be compensated for the reduction in amounts recoverable by them as a consequence of limitation being permitted. This fund would be maintained by contributions raised and collected in respect of vessels.

The Minister has given an undertaking to the Association that the provisions of the Act relating to limitation of liability for wreck removal expenses will not be brought into force until such time as a scheme has been set up which is acceptable to the Association and to the other interests concerned. This was repeated by Lord Mancroft on behalf of the Government at the Committee Stage in the House of Lords and by the Parliamentary Secretary to the Ministry of Transport and Civil Aviation when the Lords' amendments were considered by the House of Commons.

Government Oil Pipelines

The Land Powers (Defence) Act, 1958, deals, amongst other matters, with Government oil pipelines with which a number of port authorities are particularly concerned. As a result of discussions with the Ministry of Power the Association were able to reach an agreement on a number of points. The Ministry Departments concerned have undertaken not to use their compulsory powers in respect of operational land of a port authority without first consulting the port authority concerned. If both parties are not able to reach agreement the Minister of Transport and Civil Aviation is to be brought into the discussions.

In a reference to the Nuclear Installations (Licensing and Insurance) Bill, the Association remark that it is proposed that a licensee, and the Atomic Energy Authority where they themselves occupy a site, shall be under a duty to secure that no hurt to any person or damage to any property on the site or elsewhere is caused by ionising radiations emitted from any irradiated nuclear fuel in the course of carriage between places in the United Kingdom in connection with the use of the site.

The Association suggested that this duty should be extended to cover the import or export of nuclear fuel, but the Ministry of Power considered that this would raise international problems which would have to be dealt with at a later stage. The Bill was, however, amended at the Committee Stage in the House of Lords so that the duty will apply during carriage both within and between places in the United Kingdom. The whole of the sea area of a port may not necessarily be within the United Kingdom, but it appears that the amendment will cover carriage overland through a port area.

Conveyance of Radioactive and Fissile Material

With regard to the conveyance in harbours of radioactive and fissile material and an outline code of practice drawn up by the Ministry of Transport, the Association point out that the outline is vague in many respects and the subject is, of course, of a highly technical nature. For this reason, and because of their lack of technical knowledge, the Association have asked for a meeting of all the interests concerned to discuss the technical aspects, after which the Association hope to be in a position to comment further on the draft code.

It may well be some time before a code is available and, in the meantime, members are reminded that consideration should be given to the advisability of making byelaws on the matter.

Food Hygiene Regulations

Following the passing into law of the Food and Drugs Act, 1955, the Minister of Health, jointly with the Minister of Agriculture, Fisheries and Food, made new Food Hygiene Regulations under that Act, replacing the Regulations made under the earlier Acts.

The Association were consulted on the drafts of these Regulations and as a result of representations made by them and by other interests concerned, the Ministers and the Secretary of State agreed that these Regulations should not be applied to the handling and storage of meat in a port area. Similarly, it was agreed that the draft codes of practice in relation to the handling of meat and the handling of fish are not generally applicable in a port area.

During the year, the Association have been in consultation with the Ministry of Health with a view to agreeing a code of food hygiene regulations which would be applicable to dock premises and the Committee are glad to report that considerable progress has been made. It seems likely that the new Regulations will be made during 1959.

Damage to Dock Works

The report states that some progress has now been made towards deciding upon the steps to be taken to avoid or reduce damage to dock works caused by vessels as a result of a mechanical or electrical fault in the vessel or the incorrect interpretation of bridge telegraph orders by the engineer on duty.

Representatives of the Chamber of Shipping, the Liverpool Steam Ship Owners' Association and the British Tugowners' Association, who met representatives of the Association in June to discuss this problem, appreciated the great importance of the matter and the fact that resultant damage may extend far beyond the actual damage caused by the impact of the vessel with dock works. They undertook to consider with the Association what steps should be taken to prevent occurrences of this nature.

A number of possibilities have been considered and the cases which have arisen are to be examined in further detail with a view to a case being made out to Lloyd's Register of Shipping and the other classification societies for additional safety requirements on vessels.

International Maritime V.H.F. Radiotelephony

After consultation with the General Post Office, a standard operating procedure was prepared by the Navigational Aids Sub-Committee of the Association with a view to securing uniformity in the operation of the V.H.F. Radio-telephone Port Operation Service.

The General Post Office have been giving further consideration during the year to frequency planning in the maritime V.H.F. band and have asked the Association for their view on the future of the band. The Association have expressed the view that the twenty-eight channels specified in the Hague plan for port use should not be reduced and the matter is still under consideration.

It is hoped that an early decision will be made by the General Post Office so as to obviate as far as possible the necessity for the alteration of sets installed.

Work on Outside Committees

Representatives of the Association on various Committees reported on the work of the Committees during the year, which included oil pollution, safety of nuclear ships in port, radio aids, pallet standardisation, and rope definitions. On oil pollution the report expresses the view that adequate reception facilities appear to exist in U.K. ports. The use of ports by nuclear ships is of vital concern to port authorities, it is stated, but the Ministry of Transport committee's report is not likely to be available for some time.

Among the problems to be considered are the design and construction of nuclear ships, protection of cargo, suitability of ports and safety considerations for accepting ships.

The report also states that a new British Standard for pallets is being considered which is likely to include five pallet sizes. In this connection an international technical committee is preparing specifications and testing procedure. Under the decisions for a European pallet pool it has been agreed to have only one size of pallet which can be worked with the new Europe standard pallet railway van.

Quay Walls with Raking Piles at an Inclination of 1:1*

Auxiliary Pile Driving Device

Some forty-five years ago quay walls were still built as so-called gravity walls, i.e., large, massive masonry or concrete structures founded on timber piles. The earth pressure on the back of the wall was transmitted mainly to compression piles which were installed at a maximum " rake " (angle of inclination to the vertical) of 1 : 2.5.

Taking advantage of the possibilities presented by the progress of reinforced concrete construction, Dr. R. Christiani, in 1911, developed a new type of quay wall—known as the Christiani and Nielsen wall—of a basic form which has been in use ever since. It was essentially a structure of L-shaped cross-section supported on sheet piling at its front edge and on a high piled foundation at the rear. The back of the wall was provided with an earth fill. A characteristic feature of the piled foundation was that it comprised at least one row of raking piles which had the function of taking up the major part of the horizontal forces acting on the wall.

Developments in Design of Quay Walls

The increasing draught of sea-going vessels required greater depths of water alongside quay walls, and this led to modification in their design in that the sheet piling was placed at the back of the wall instead of along the front edge. The object of this arrangement was to enable an earth slope to be provided under the wall, so as to reduce the depth of soil that the sheet piling had to retain. In the days of timber piles this was on important consideration.

Sheet piling located at the front edge of the quay wall offers an advantage, however, inasmuch as the foundation can then be provided with backward-raking tension piles serving to anchor the wall structure securely into the ground behind it. Such anchorage is an important factor in ensuring the stability of the wall. Whereas it is rare for a wall to collapse as a result of failure of the sheet piling, there have been many instances of mishaps to quay walls arising from inadequate anchorage. The provision of a sufficient number of anchor piles acting in tension will obviate any risk of the wall being pushed forward by excessive earth pressure due to high surcharges. In addition, the anchor piles pass through the potential planes of rupture of the soil, thereby producing enhanced friction in such planes and consequently increasing the factor of safety.

Until a comparatively short time ago it was not possible to drive piles to a rake exceeding 1 : 2.5. The use of tension piles driven to a greater angle of inclination to the vertical has the advantage that not only are the forces in these piles themselves reduced but also that there is a reduction in the forces acting in the compression piles. It is thus possible to effect a saving in the number of tension and compression piles required. A further consideration is that in the case of tension piles driven to only a fairly small rake the force in the pile is liable to vary considerably with the loads acting on the wall and may, indeed, alternate between tension and compression, so that it may be necessary to adopt a higher factor of safety in the design of such piles. (German recommendations envisage a factor of safety of 2 for the design of tension piles having a rake not exceeding 1 : 2.) This disadvantage is obviated by increasing the rake of the piles.

* Based on an article in German by Dipl.-Ing. Otto Tolle, published in "C N Post," August, 1958.

Fig 2. Sheet piling with Peine anchor piles driven to a rake of 1 : 1.

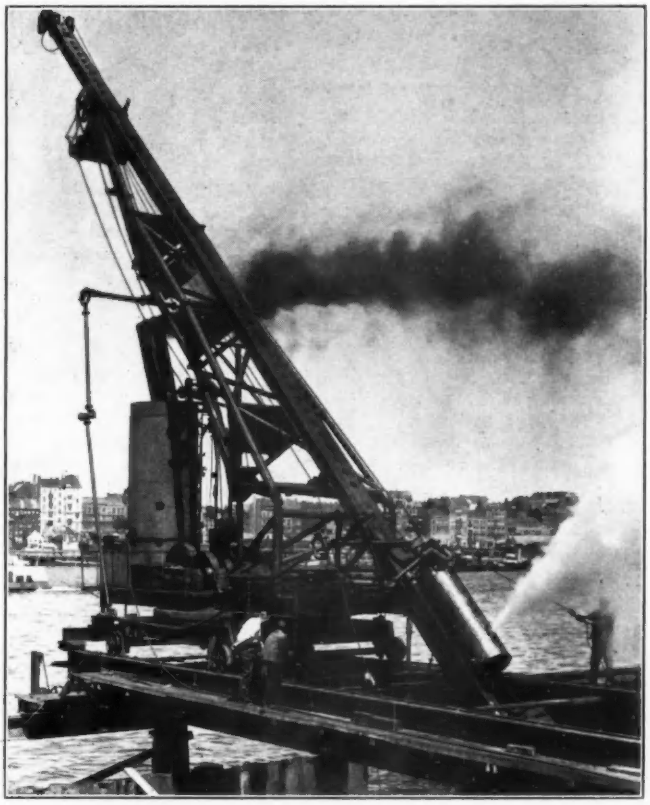


Fig. 1. Menck piling frame converted for driving 1 : 1 raking piles.

In Germany, the design of horizontal anchorages for quay walls is usually based on a factor of safety of 1.5. Anchor piles driven to a rake of 1 : 1 constitute, as it were, an intermediate case between normal tension piles and normal anchorages, and a factor of safety of 1.75 is recommended for their design, subject to verification of the ultimate tensile load-carrying capacity of such piles by means of loading tests. Raking anchor piles have the advantage over horizontal anchorage systems that they are installed by driving (thereby dispensing with the need for excavation behind the wall) and that they penetrate into compact soil strata situated far below the surface.

Advantages of Steel Piles

Steel is the only suitable material for raking piles driven at an inclination of 1 : 1. Reinforced concrete is unsuitable because the reinforcement is, generally speaking, only adequate for resisting the tensile forces for which it has been designed. It provides insufficient reserve strength for coping with the flexural loads of unknown magnitude that are liable to occur in consequence of possible settlement or accidental deflection of the pile during driving (which may, for instance, be caused by its encountering an obstacle in the ground). On the other hand a steel pile such as, say, the Peine PSp 30 with a cross-sectional area of 111 cm^2 and a section modulus of 1180 cm^3 can, when loaded to a tensile force of 80 tons, safely take up an additional bending moment of about 8 ton-metres (for a permissible steel stress of 1400 kg/cm^2).

Piles driven to a 1 : 1 rake were first used in 1952 for the

Quay Walls with Raking Piles—continued

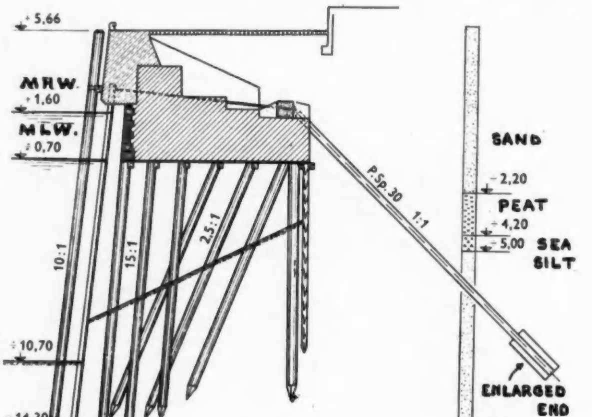


Fig. 3. Strengthening of quay wall at Hamburg.

modernisation and strengthening of a quay wall in the Port of Hamburg (Fig. 3). A greater depth of water was required alongside the wall, which necessitated the provision of new sheet piling and additional anchorage. Peine PSp 30 piles 18 m. in length were employed for the latter purpose. These piles were equipped with enlarged ends—consisting of two welded-on 2.50 m. lengths of the same pile section—in order to increase their pull-out resistance. They were designed for a maximum allowable tensile load of 80 tons per pile, based on appropriate loading tests. In this particular case a makeshift device was used for driving the piles. It consisted, in the main, of a simple fixed trestle structure carrying the leader for guiding the piles. Driving was effected by means of a steam-operated rapid-stroke hammer.

Bearing Trestle to Assist Driving

The engineering firm of Menck and Hambrock, Hamburg, subsequently developed an auxiliary device for use in conjunction with their standard pile frame, permitting raking piles to be driven to an inclination of 1 : 1 by the usual methods. This auxiliary device consists essentially of a bearing trestle which raises the pivoting point of the leader to a sufficient height for the superstructure of the piling frame to clear the steam boiler when the leader is inclined to a slope of 1 : 1. Tilting the frame is effected in the normal way by means of a screw spindle. A piling frame converted for dealing with 1 : 1 raking piles has a somewhat smaller overall effective height (owing to the fact that one section of the tubular latticework superstructure has to be removed for effecting the conversion), while for reasons of stability the maximum permissible pile weight has to be reduced. This latter limitation does not, however, constitute any real disadvantage with regard to 1 : 1 raking piles, as steel piles are invariably used, and these are appreciably lighter than the concrete piles that a normal piling frame must be capable of handling. A frame adapted for the driving of raking piles of this kind can be converted back into a standard frame.

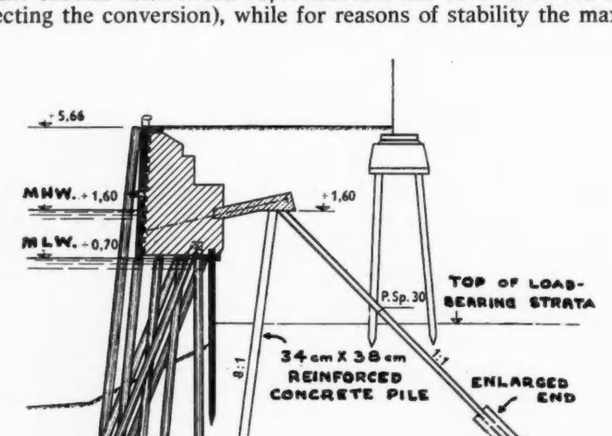


Fig. 4. Strengthening of quay wall in Blohm & Voss shipyard, Hamburg.

The actual driving of the piles can be effected either by means of a double-acting rapid-stroke hammer or by means of a single-acting steam piling hammer. The latter type is probably better suited for the purpose, as the increased wear and tear of the percussion piston, due to the inclined position of the hammer, is less serious than in a double-acting hammer. The angle at which the hammer has to operate will, of course, reduce the effective blow delivered on the pile; if necessary, a larger size hammer can be employed to compensate this.

In recent years, 1 : 1 raking piles have been used on a number of jobs. Thus, an old quay wall in the Blohm and Voss shipyard at Hamburg (Fig. 4) was strengthened by providing it with a rearward projecting reinforced concrete slab which had the effect of displacing the resultant force away from the front of the wall and relieving the existing timber sheet piling of the earth pressure acting upon it. Additional anchorage of the wall was obtained by installing 1 : 1 raking piles with enlarged ends, which were designed for a load of 78.5 tons per pile on the basis of loading tests. Owing to the presence of buildings behind the quay wall, such piles constituted the only practicable method of anchorage.

A section through a new quay wall structure incorporating 1 : 1 raking piles acting in tension is shown in Fig. 5. The design load on these piles (which in this case were not provided with enlarged ends) was 46.5 tons per pile. The design of this wall, which was built at Hamburg in 1956, is also of interest in that it shows that with the method of anchorage employed there is no need to provide a massive gravity-type structure nor any appreciable amount

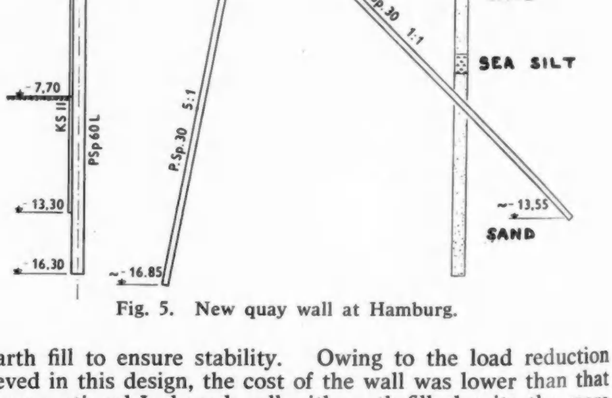


Fig. 5. New quay wall at Hamburg.

of earth fill to ensure stability. Owing to the load reduction achieved in this design, the cost of the wall was lower than that of a conventional L-shaped wall with earth fill, despite the more complicated shape adopted for the cross-section. It should be noted, however, that with such a light form of construction the available reserve stability to resist loads in excess of the design load is smaller than in the case of an L-shaped wall, where the ratio of dead to live load is far higher. The sheet piling consisted of a combination of Peine PSp 60 piles and Krupp KSII sheet piles. The Peine piles were the main structural members of this system; the Krupp sheet piles served merely as an infilling screen and were therefore driven to a smaller depth of penetration. A sheet-pile wall of this type can take up a considerable vertical load (42 tons per lineal metre in this particular case) in addition to the flexural loading due to earth pressure.

Book Reviews

Practical Dredging by Hubert R. Cooper, F.R.Met.S., F.R.A.S., M.I.N. Published by Brown, Son & Ferguson, Ltd., 52-58 Darnley Street, Glasgow, S.1. Price 65/- net.

In the past there have been very few books written on the subject of dredging, and those there have been have dealt with the subject either theoretically or from a scientific angle, explaining hydrography, cartography and oceanography with little or no reference to the practical problems of performing the operation of dredging. None of these books looked at dredging from the angle of the Dredger Master or owner.

This new book deals with the practical side of dredging, explaining the various types of dredger now available, their functions and suitability for maintenance or development works, and how to manœuvre and operate them. It also deals with preliminary surveys, boring and site investigations and, in fact, the whole process from its commencement, including reclamation of land for industrial sites, docks and harbours. The manning and maintenance of craft, overhauls, removal of buckets, moorings, communications, etc. are subjects with which the author is familiar and he has written his book for all those interested in this vital part of dredging. A feature of the book is the very large number of illustrations which cover the wide range of equipment in use.

Captain Cooper has, over the last twenty years, gained his experience in the Harbour Service of the South African Government as well as in the British Transport Commission, in which he was appointed Dredging Superintendent, Scottish East Coast Ports. In his book he has combined his own practical experience with details obtained from some of the foremost experts in the dredging world and anyone connected in any way with dredging or responsible for the clearance of docks and channels will find this work a very useful reference and guide.

The Design of Prismatic Structures by A. J. Ashdown. London: Concrete Publications, Ltd. Revised edition, 1958; 85 pages. Price 9s., by post 9s. 8d.

The publication of a revised edition of this book is opportune in view of the increasing popularity consequent upon the economy of prismatic-slab roofs. As in the previous edition, examples are given of the design of this type of roof and other structures such as trough bunkers which comprise an assembly of contiguous and continuous rectilinear slabs and which are also known as hipped-plate structures. In addition to minor alterations to bring the work up to date, new information is given on the analysis of prismatic-slab roofs in which the angle between adjacent slabs is much less than 30 deg., that is slab roofs the profiles of which approximate to a curve. A design for a prestressed concrete edge-beam for such a roof is also given.

The Design of Land Drainage Works by Roland Berkeley Thorn, B.Sc., A.M.I.C.E., A.M.I.Struct.E., A.M.I.W.E.; 235 pages. Price 35s. Butterworths Scientific Publications, London.

The subject of land drainage, within the meaning of the Land Drainage Act of 1930 and the River Boards Act of 1948, includes flood protection and alleviation, ground-water level control, water conservation, irrigation, and sea defence works for the protection of low-lying land. This book is a collection of Papers discussing land drainage projects similar to the type normally carried out by River, Conservancy and Drainage Boards under these Acts. The Selection has been taken from the Proceedings of the Institution of Civil Engineers, Institution of Water Engineers and from technical journals. The object of the book has been to provide for everyday use a concise source of reference on design detail, for both the experienced designer and the newly graduated engineer.

The papers have been selected so that as broad a field as possible is covered. When several subjects of a diverse nature by different authors are put together in book form, it is difficult to obtain a general continuity and unity of matter. To overcome this the Papers are accompanied by explanatory Notes that serve both as introductions and as a means of supplementing the information contained in them, by reference to allied subjects, and to previous and subsequent works.

Manufacturers' Announcements

Auckland Harbour Bridge

In December, 1958, Span No. 3 of the Auckland Harbour Bridge, 581-ft. long and weighing 1,200 tons, was successfully floated into place at a height of 75-ft. above the water. This is one of the biggest floating-in jobs ever undertaken and was made hazardous by the risk of a storm arising before the span was safely landed on its piers. A period of suitable tides had to be selected for the work and arrangements made with the Meterological Department to get the best possible advice on weather forecasts.

The huge steel girders of the span, which themselves stand 80-ft. high, were first erected on top of Span 6 at the south end of the bridge. Part of Span 6 was then detached to act as temporary staging and four pontoons were floated in beneath it. On the rising tide, assisted by pumping out water ballast, the pontoons lifted the span clear of its supports. Watched by many thousands of spectators, the pontoons with their impressive load were towed out to the gap between Piers 2 and 3 where the span had to be landed.

View from the South showing Span 3 being floated out to be landed in position between piers 2 and 3.

At high water the girders were accurately located some 18-in. above the top of their supports on the piers. Then as the tide fell and water ballast was pumped into the pontoons, the span was safely landed in its permanent position.

Designed by Messrs. Freeman, Fox & Partners and built by the Cleveland Bridge & Dorman Long Partnership, the Harbour bridge is due for completion in May, 1959. The work is being carried out for the Auckland Harbour Bridge Authority under the chairmanship of Sir John Allum.

Quick-action Pipe Coupling

A quick-action pipe coupling for use on pneumatic or hydraulic pipelines has been developed by Simon Handling Engineers Ltd. Capable of withstanding considerable pressures, and equally suitable for use on rigid or flexible pipes, the patented quick-action coupling sets new standards in speed and toughness.

Lever and claw fastenings make or break connections in a fraction of the time required for previous unions, and a fitted rubber sealing ring gives an airtight connection. Each coupling consists of two rings with flanged ends. Fixed to one ring are the spring-loaded claw fasteners. A connection is made when the two flanges are united and the claws closed over the joint so that the flanges are held tightly together, forming an airtight seal.

Levers and claws are specially designed to slide easily over any surface, and when the connection is broken the toggles are spring-loaded against the pipe to minimise damage risks. Couplings are made for welding on to 2-in.—8-in. thin-walled rigid or flexible pipes and for screwing on to heavier pipes.

Manufacturers' Announcements—continued

Extruded Aluminium Gratings and Treads

Until a few years ago the popular material for grating was steel, but this is subject to heavy corrosion in marine atmospheres and the introduction of aluminium as a grating material has helped a great deal in solving the problem. Until recently the only types of aluminium grating available were produced from bars and rods and a type of rivetted manufacture, and whilst their use has become widespread the extruded grid form of aluminium gratings and treads has been found most suitable for marine applications.

There are many advantages of this type of installation over the more conventional steel types. A greater loading strength is achieved and yet the overall weight of the installation is much reduced. Under normal marine operational conditions aluminium will not corrode and consequently the need for periodic derusting and repainting is eliminated. Moreover, whilst retaining maximum anti-skid properties, the aluminium gratings are non-sparking and non-magnetic, thus reducing fire risk.

" Alaflor " grating installation aboard a British built oil tanker.

Archibald Low & Sons Ltd., of Glasgow, have for some time been manufacturing and marketing a type of aluminium grating known as " Alaflor." This is supplied rectangular, square punched, or plain (i.e. unpunched). Of these, the most popular is the rectangular punched type, mainly because of the reduced weight, increased light penetration and improved drainage factors, although the square punched grating has greater surface traction.

Great strength and rigidity are claimed to be the result of the I-beam extrusion principle employed. Panels are formed by welding together 6-in. wide extrusions and banding the open ends with aluminium alloy flat bars. Longitudinal serrations and a raised tip at either end of the punched pattern prevents forward or sideways slip.

Decksmetal Surface Reinforcement

A low-priced surface armour for use with mastic asphalt or rubber compound floorings, has been introduced by Causeway Reinforcement Ltd., manufacturers of Hexmetal steel cellular reinforcement.

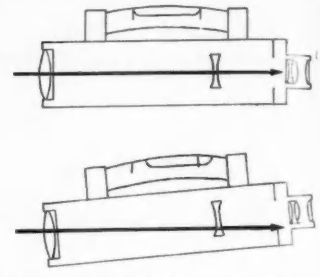
Decksmetal is manufactured in 4-ft. long strips in such a way that easy and speedy assembly on site is permitted. By means of a special tongue and slot design the strips can be fabricated into a continuous floor armour which fully stabilises the asphalt and provides a strong surface. The mesh is provided in 14 gauge material 1-in. deep and each cell measures 3-in. It is treated with a bitumen compound before despatch to ensure easy adhesion to the asphalt flooring. Where it is to be laid on soft underlays, a flat support strip is provided.

Automatic or Self-Aligning Level.

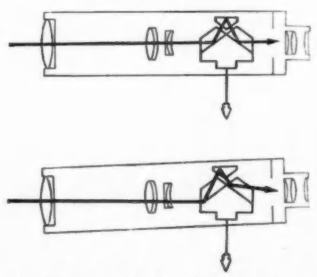
Cooke, Troughton & Simms Ltd. and Hilger & Watts Ltd., have collaborated in the design and development of a novel and patented form of optical stabiliser which can be incorporated in the telescope of a surveyor's level in order to effect automatic compensation for any small errors in levelling. Thus the care which is necessary in setting up a conventional spirit level instrument is no longer needed and much time and fatigue is saved. Once the instrument has been approximately levelled by means of the circular spirit vial the stabiliser sets the line of sight in a horizontal plane.

The method of compensation does not depend upon any need to magnify mechanically the residual tilt of the instrument, but obtains the equivalent correction by purely optical means. The moving part of this compensator carries two reflecting prisms and is suspended by four flexible metal strips forming a flexure-pivot. This type of pivot is particularly suitable for this purpose since it is frictionless yet robust; it can be operated an infinite number of times and yet returns unfailingly to the correct position and it allows the compensator to come to rest in the vertical plane with a sensitivity of less than one second of arc.

The telescope is of the internal focussing type so constructed as to allow the stabiliser



With a conventional level the line of sight is level when the bubble is central. If the telescope is tilted points on a level line are seen above or below the cross-line.



In the " Autoset " level telescope there is a stabiliser consisting of two prisms on a suspended mount. If the " Autoset " is tilted the stabiliser swings like a pendulum and keeps the horizontal ray on the cross-lines automatically.

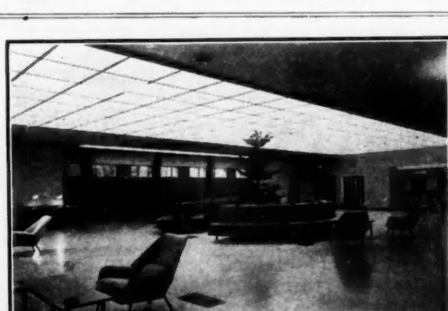
to be housed between the focussing lens and the reticule. By virtue of the prism system the observer sees an erect view of the measuring staff.

Extensive trials have been held by the two companies to confirm that these instruments will give accurate results in the field under all conditions, including wide variations of temperature. The ability of the stabiliser to withstand continuous vibration and bumping tests has also been investigated at length.

New Passenger Accommodation at Southampton Docks

Continuing their post war policy of providing up-to-date passenger facilities at Southampton Docks, the British Transport Commission recently brought into use a new waiting hall to serve Berths 30 to 33 on the Itchen Quays.

The new accommodation is of single storey construction and the facilities provided include an Immigration Office, Shipping Companies' Ticket Stand, Bureau de Change, Buffet, Toilets and Telephones. Access for passengers is provided from the rail platform on the west or landward side by a communicating corridor 8-ft. wide and



42-ft. long. The Waiting Hall itself is 69-ft. long by 65-ft. wide.

The treatment given to the Waiting Hall is in contemporary style with wall coverings in straight grained elm veneer and colourings are of pastel shades to match those used in the furnishings. The furniture generally is in Vaumol hide finish with occasional chairs in soft upholstery.

The lighting installed is a suspended Modolume system covering a considerable area of the ceiling. The under-floor heating is the Pyrotenax electrical system, the floor itself being finished with a thermo-plastic tile covering in shades of grey.

It is anticipated that the Itchen Quays will be used principally by vessels of Royal Mail Lines Ltd., Holland-America Line and French Line. The building has been constructed by direct labour under the supervision of the Chief Docks Engineer, Mr. J. H. Jellett, O.B.E., M.I.C.E.